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Environmental History and Cultural Ecology

of the North Fork of the Eel River Basin, California

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Preface

If one visits the countryside surrounding the North Fork of the Eel River in spring, its gentle beauty can be inspiring. Green hillsides are carpeted with wild flowers, deer are everywhere, springs flow freely, and the canyon of the North Fork roars in the distance.

This seemingly forgotten corner of California, hidden deep within the North Coast Ranges, appears at first glance to be a pristine wilderness, rich in natural resources and rugged beauty—somehow untouched by modern civilization. But this is not a wilderness. For thousands of years prior to Euro-American settlement, hundreds of people called the North Fork basin home. They managed to secure nearly every item they needed for food, clothing, housing, and the other necessities of life directly from the environment of the North Fork basin and the surrounding region.

During the early part of the historic era, hardy homesteaders settled on isolated parcels of land miles from the nearest wagon road. A small rural community with schools, a post office, and even a general store managed to take hold in the remote North Fork basin. By about 50 years ago most of these homesteaders had left. Today fewer people live within the North Fork basin than at any time in the last several centuries. Therefore, while it appears to be a wild and pristine place, that is simply not the case. There has been a long and eventful relationship between humans and the ecosystem of the basin. The history of this human-ecosystem relationship and how the environment has responded to the land-use activities of humans is the theme of this study.

I am grateful to and thank the many residents of southern Trinity County, including members of the Native American community, who provided me information on the history and environment of the North Fork basin. Special thanks go to Coyote, Lee and Irene Stapp, Winston Garcelon, the late Leona and Ralph Miller, Warren Cummins, Wayne and Bertha Burgess, and Arden Stillwell for the many interesting facts about the region that they provided. I would also like to thank local historian Max Rowley for his generous help and suggestions. Floyd Barney, who was born on a homestead near the mouth of Hull's Creek and the North Fork, contributed a considerable amount of historic information on the southern portion of the basin.

Lila Lee of the Mendocino Historical Society was a tremendous help showing me how to work with their excellent collection of historical materials on the Yolla Bolly country (northern Mendocino and southern Trinity Counties). Also, thanks to Alice Jones of the Trinity County Historical Society in Weaverville for her help working with their fine collection.

I am indebted to the numerous natural resource scientists and technical experts who were contacted during this study. I thank them and appreciate their willingness to share information—a list of those contacted is provided in the Personal Communications section. I would also like to thank Dwight Simons of Sonoma State University for his help and encouragement in this project. Kathy Heffner-McClellen, Anthropologist, Six Rivers National Forest, was especially helpful in providing me with cultural information on the Wailaki. Dennis McKinnon, Civil Engineering Technician, also from the Six Rivers National Forest, with his extensive knowledge of computer graphics, helped to improve and produce the final maps.

I also appreciate the continuing support that I have received over the last decade for my research from Ken Wilson, Forest Heritage Resources Program Manager, at Six Rivers National Forest. Linda Lux, Historian, at the Forest Service Regional Office in San Francisco, was instrumental in guiding me through the publication process. Ralph McNees displayed a tremendous amount of patience and understanding in editing my original manuscript. Lastly, I want to thank my wife, Hélène, for her editing and all of the useful ideas and suggestions she has provided in our many discussions on the history and environment of the North Fork of the Eel River basin.

Introduction

Recently, the Forest Service has begun to shift toward a new paradigm for the management of National Forest lands. Although this new model is still evolving, its broad outlines are emerging. It calls for an ecosystems approach in managing the National Forests. That is, plant and animal species are viewed as forming an interdependent and complex web of relationships that must be dealt with at the ecosystem level. Land management decisions that affect one species or a portion of the environment have a rippling effect that can ultimately influence an entire ecosystem, often with unpredictable consequences.

In an ecosystems approach to forest management, professionals from the biological, physical, and social sciences contribute their expertise to provide for a broader understanding of the effects that ground disturbing activities can have on the environment. In fact, one of the greatest benefits from working for the Forest Service has been the opportunity to work with biologists, botanists, geologists, foresters, and other natural resources professionals. In working together, all have learned that each of us has something to contribute to a holistic or ecosystems approach to forest land management. This collective knowledge provides for a better understanding of the potential effects that human land-use activities can have on the environment.

I believe that cultural anthropologists, historians, and archaeologists with their distinct perspectives can help to provide a deeper understanding of past environmental trends needed for ecosystems management. Without an understanding of historical ecological processes and past human land-use activities, any attempt to make recommendations about the management of today's National Forests from an ecosystem management perspective will be inadequate. [A critical review of the literature and theoretical basis of cultural ecology is beyond the scope of this study. For an overview on this subject see Bettinger (1991), Ehrlich et al. (1973), Hardesty (1977), Sarma (1977), and Steward (1955).]

For nearly a decade I have been conducting research on the present and past environment of the North Fork of the Eel River basin in southern Trinity and northern Mendocino Counties, California. This research suggests that human occupation has influenced the environment of the region for hundreds of years: just as changes in the archaeological record occur through time, so do changes to the region's ecosystem. Neither culture nor nature is static, and hunter-gatherer groups had a substantial impact on their environment. Because of their relatively simple technologies, their profound effects on the environment are often overlooked or minimized. The peoples who inhabited the North Fork basin during prehistoric times were, however, far more than passive observers of the environment within which they lived. The concept of a pristine wilderness untouched by human activities during the prehistoric era is not valid for this region. Aboriginal groups affected their environments through their subsistence and cultural activities. Thus, a dynamic interaction existed between the environment and the lifeways of the aboriginal inhabitants of the region.

In this publication, baseline data on the region's environment during the ethnographic period are formulated through what can best be termed "environmental reconstruction." That is, through historical research, interviews with local residents, and on-the-ground observations, a model of the region's environment prior to the entry of Euro-Americans into the area is documented. Paleoclimatic and pollen core-data are then integrated with these baseline data to formulate a diachronic catchment model (accounting for the variable or dimension of time) of the region for the prehistoric period. In effect, this catchment analysis delineates the potential resource base and procurement opportunities available to the aboriginal population through time and in a changing environment. The purpose of such a model is to permit researchers, as Richard Gould (1975:153) writes, to "examine the universe of edible resources in the region from the point of view of how human beings must organize their movements, technology, and social groups in order to collect them effectively."

The catchment analysis is followed by an overview of the ethnographic data for the region about the kinds of natural resources utilized by the Wailaki and Lassik, who inhabited the region during the late prehistoric period. In light of the resource base outlined in the North Fork catchment analysis and the ethnographic record, the final part of this study presents some suggestions on potential prehistoric site settlement patterning and the kinds of sites likely to be found in the North Fork region.

Chapter 1
Historical and Environmental Setting

In northwest California, several variables including latitude, distance inland from the Pacific Ocean, altitude, and topographical orientation greatly influence climatic conditions, including the amount of precipitation. Subtle variations in climate have created numerous micro-environments, each with a unique mixture of plant communities. Consequently, the environmental data presented in this study are specific to the North Fork basin. While some of the data and conclusions presented can be used to make generalizations about changes to the environment outside the basin, caution is necessary because each region of northwest California has a unique set of environmental, historical, and prehistorical variables.

Prehistory and History

This region of the North Coast Ranges has been inhabited by humans for about 5,000 years. It is not clear just when the first peoples arrived in the North Fork of the Eel River region or where they came from. Linguistic data suggest that about 1100 A.D. speakers of an Athabascan language moved into the region displacing an earlier culture. During the ethnographic period (the time immediately before Contact Period) the North Fork region was inhabited by the Wailaki and closely related Lassik.

With the beginning of the historic era, a radical change in human land-use practices took place. This change created new forces fundamentally affecting the complex web of relationships established over a long period between the plants and animals and the prehistoric peoples of the region. Thus, as is documented in this study, the terrestrial and aquatic ecosystems today are very different than they were at the beginning of the historic period.

Settlement and development of the region during the historic era can be divided into distinct periods:

1854-1865: Settlement and Conflict Period

During this period, Euro-Americans first entered the North Fork basin. Conflict with the local Indians was immediate and violent. In little more than a decade, the Wailaki and Lassik were no longer living a traditional way of life. Many were killed and most of the survivors were placed on the Round Valley Indian Reservation. The major land-use activity during this period was the hunting of deer for their hides. [For an overview of this period see Keter (1990).]

1865-1905: Ranching Period

Large ranching operations dominated the North Fork basin during this period. Most of these operations were located to the south in Round Valley or to the west along the main Eel River. The North Fork basin was used as seasonal range for sheep and cattle. By the late 1860s, sheep dominated the rangelands of the basin. During the late 1870s when the number of sheep reached its highest point, 40,000 to 60,000 sheep would spend at least some part of the year in the North Fork basin. In addition to ranching, some small subsistence homesteads were established within the basin. [For an overview of this period see Keter (1994).]

1905-1940: Homesteading Period

In 1905, the Forest Service took over administration of nearly all the public lands within the North Fork basin. During the next decade or so a number of homesteaders settled in the basin on small 160 acre subsistence homesteads. By the 1930s, most of these homesteads were abandoned. Most of these homesteaders sold out to the larger ranching operations in the region.

1940-1990s: The Modern Era

By the late 1940s, the market for Douglas-fir began to improve and logging became the major economic activity in the region. A few families remained, but by the 1980s there were fewer people living in the North Fork basin than at anytime in the last several centuries.

During each of these periods, differing land-use activities resulted in unique impacts on the basin. As part of the process of environmental reconstruction, these impacts and their effects on the environment are documented in this study. This information is then used to establish the baseline environmental data for the ethnographic period.

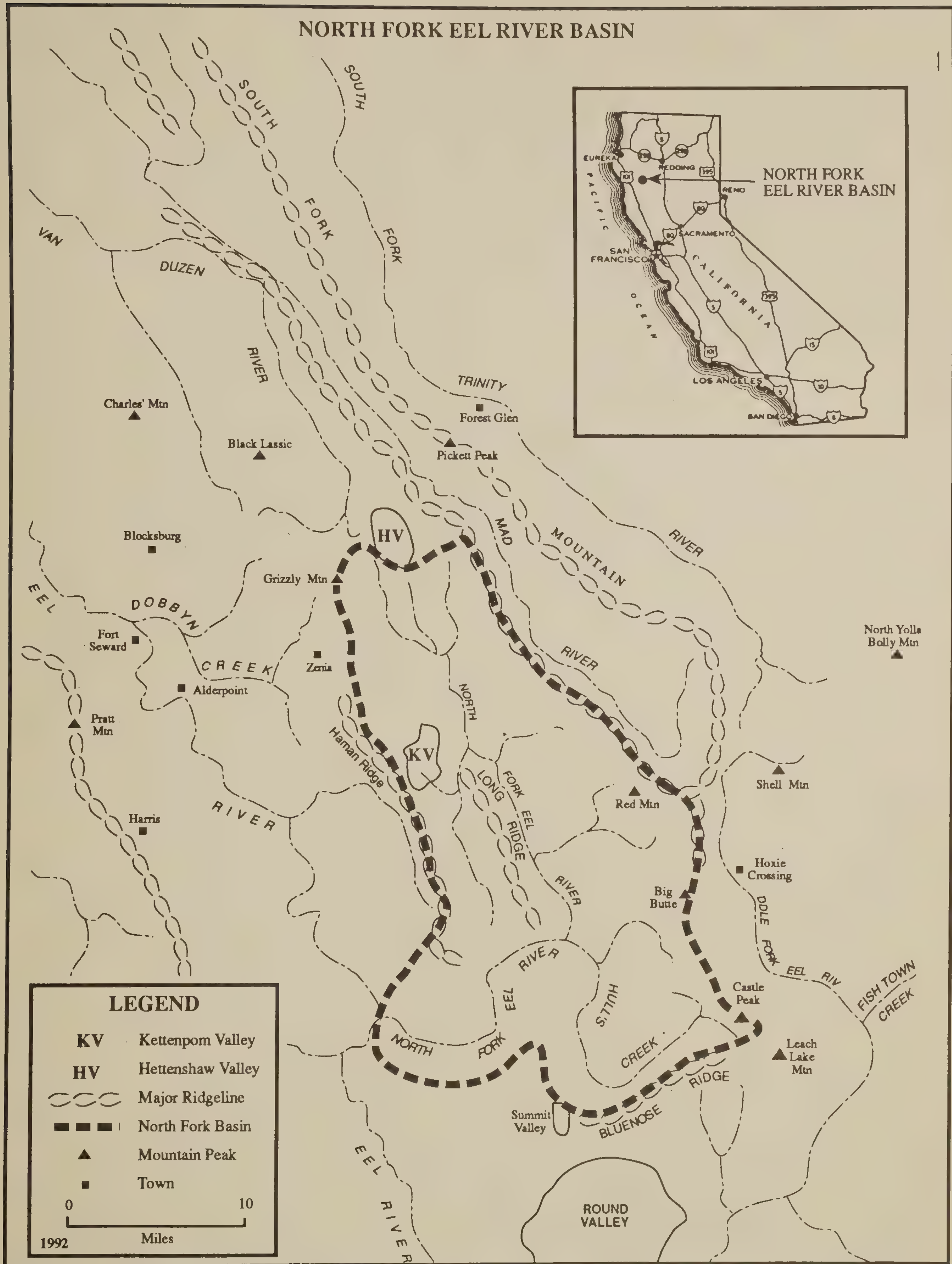
The Environment

The North Fork basin is still remote, relatively undeveloped, and remains much as it was when ethnographer Pliny Goddard (1924:217) visited the area in 1922:

> The river bed is rather narrow for the most part, choked here and there with great boulders and bordered by steep walls wherever the ends of secondary ridges coming down to the stream have been cutoff. There are [a] few flats by the stream, but many of them subject to flooding at high water...are unsuitable for village sites. The mountain sides are fairly steep, with scattered oaks, buckeye, and pines, and are cut through with rough gulches difficult to cross.

The North Fork of the Eel River drains an area of approximately 240 square miles and is a major tributary of the Eel River. The region is located (Map 1) in the southwestern portion of Trinity County and northeastern Mendocino County. Elevations range from approximately 1,000 feet at the confluence of the North Fork and main Eel River to above 5,000 feet in the northwestern part of the basin near Round Mountain and in the southeast portion in the Castle Peak area.

The climate is Mediterranean with cool, wet winters and warm (hot at lower elevations), dry summers. Snow above 3,500 feet is common in the winter and sometimes falls at lower elevations, but it rarely remains for more than a few days. There is no official weather station within the basin but precipitation is estimated to average about 50 inches per year, with most of it falling between October and March. Many of the smaller tributaries become dry by early summer, and summer flow of the North Fork is low to nonexistent. Winter precipitation can result in heavy stream flows, and flooding is not uncommon.



Map 1, North Fork Eel River Basin

Vegetation Associations

The North Fork basin, as classified on California vegetation maps by Küchler (1977:map), contains three major vegetation types: Oregon Oak Forest (*Quercus*), Mixed Evergreen with Rhododendron (*Arbutus*, *Pseudotsuga*, *Lithocarpus*, *Quercus*, *Rhododendron*) and Coast Range Montane (*Abies*, *Pinus*, *Psuedotsuga*). In this region, the Oregon Oak forest type includes black oak (*Quercus kelloggi*), which usually grows in association with Oregon oak (*Quercus garryana* referred to by its local name, white oak, in this study).

More specific vegetation type classifications have been developed by ecologists on the Six Rivers National Forest for the North Fork and adjacent region. This classification system denotes the potential natural vegetation types (PNV) occurring in the area. The most relevant PNV types for this study include the Douglas-fir series with black oak as a subseries, white oak series (with several subseries present), white fir series, and the grassland type (Jimerson et al. 1994:75-80).

Within the North Fork basin, forested areas are comprised primarily of stands of Douglas-fir (*Pseudotsuga menziesii*). Madrone (*Arbutus menziesii*) are found mostly to the west of the North Fork of the Eel River. Tanoak (*Lithocarpus densiflorus*) are found only in a few areas of the basin, most commonly in the northwest portion of the basin on north facing slopes. Some disjunct stands of tanoak were noted at higher elevations in the southern portion of the drainage on north-facing, topographically shaded slopes adjacent to the county road that leads to the confluence of Hull's Creek and the North Fork of the Eel River (see Map 1), near its intersection with the Round Valley Road. These stands are separated by at least several miles from the more northerly stands of tanoak in the basin.

The Oregon Oak forest (herein referred to as oak woodlands and defined as areas with tree cover greater than 30 percent), grasslands, oak savanna (defined as areas with tree cover less than 30 percent), brush lands, and areas of limited vegetation (including many endemic species) on poor serpentine soils form a complex mosaic throughout the North Fork basin. At higher elevations in the northwestern part of the basin and in the Castle Peak region, white fir (*Abies concolor*) predominates.

Throughout the region—for example near Red Mountain and along portions of the western slopes of Long Ridge—there are areas that were called "roughs" by the local homesteaders. These areas of poor soils (often serpentine or laterite) or rocky outcrops usually contain sclerophyllous shrubs—hard leaved brush species including manzanita (*Arctostaphylos* spp.), gray pine (*Pinus sabiniana*), or live-oak (*Quercus chrysolepis*). Some Jeffery pine (*Pinus jeffreyi*) are also found on the serpentine soils.

Natural and anthropogenic (human-caused) fires, the introduction of livestock and exotic plant species, and other factors appear to have greatly influenced the extent and distribution of vegetation associations within the basin during human occupation of the region. These factors and their effects upon the terrestrial ecosystem are discussed in the next portion of this study.

Chapter 2
Fire History of the North Fork Basin

Field surveys, interviews with long-time residents, historical accounts, and a review of silvicultural data provide evidence that, prior to the historic era, the oak woodlands of the North Fork region were more extensive than they are today and that there were fewer stands of Douglas-fir. In many areas, the oak woodlands have been completely overgrown by dense stands of Douglas-fir since the beginning of the historic period in 1854. To a lesser extent, Douglas-fir have also invaded some grasslands (most often the smaller sized glades surrounded by oaks), especially in the northwest portion of the study area.

Research for this study suggests that aboriginal burning in the North Fork region was a primary factor in determining forest composition during the prehistoric period. The lack of burning since the beginning of the historic period has encouraged the growth of Douglas-fir in areas that were previously oak woodlands. The hypothesis formulated to account for these changes is that the Indian groups of this region were "managing" their resource base by using fire as a tool to maximize productivity of desired resources. This use of anthropogenic fire ultimately prevented the climax stage of vegetation (Mixed Evergreen Forest dominated by Douglas-fir) from occurring in this region. As will be documented in this study, for much of the North Fork basin, the Oregon Oak Forest is a seral (intermediate) stage for the Mixed Evergreen Forest (personal communication, Thomas Jimerson, Ecologist, USDA Forest Service). The oak woodlands were the richest vegetation community type for the gathering of subsistence resources by humans. Moreover, certain wildlife species (especially deer) were also dependent on the oak woodlands and, ultimately, provided additional subsistence resources to the local aboriginal population.

The Role of Fire in the Environment

Fire has been a factor influencing the environment of the North Fork basin for thousands of years, long before humans first entered the region. The introduction of anthropogenic fire during the prehistoric period, therefore, took place within a region where the vegetation associations were adapted to periodic burning.

Historically, natural fires caused by lightning were not uncommon in this region. The majority of thunderstorms and lightning strikes, however, occur further to the east in the Yolla Bolly Mountains and around the southern end of South Fork Mountain. There is an average of five thunderstorms per year in this region, with an average of about five lightning strikes per storm. Thunderstorms most commonly occur in

the months of August and September. In some years, there is an intense period of thunderstorm activity with many lightning strikes in one storm (personal communications, Dick Gassner, Fire Management Officer, USDA Forest Service, and Orvil L. Robinson. U.S. Weather Service, Eureka). This phenomenon occurred in 1987, causing numerous fires in the North Fork basin including the 16,000-acre Travis Fire. Given the amount of thunderstorm activity in and adjacent to the North Fork basin, it seems reasonable to conclude that prior to the prehistoric period, fires resulting from natural causes occurred periodically within the basin.

Ethnographic data on the southern Athabascans, as well as ethnographic analogy with other hunting and gathering groups in environments with similar fire regimes, suggest that anthropogenic fire was used extensively and for many reasons. Anthropogenic fire within the North Fork basin, therefore, would have resulted in a shorter frequency between burns (probability of fire occurring in a given year), as well as a shorter rotation period (the mean time for fire to disturb an entire area) than if fires had resulted only from natural causes. Thus, anthropogenic fires would have been a more significant factor than natural fires (or at least an additional cumulative factor) in influencing vegetation associations and the environment. Absence of any human-caused burning prior to the historic period, however, would still have resulted in an environment more open than that of today. The reasons for this conclusion are outlined below.

The authors of one of the major studies of California vegetation note that little is understood of the past burning practices in forests of the North Coast Ranges (Barbour and Major 1977:408-409). In the early 1900s, in *The Silva of California*, Willis Linn Jepson (1910:10-11), a professor at the University of California, outlined the evidence for Indian burning practices, and stated that:

> With an annual average rainfall of forty to fifty inches, with a rich soil and with an increasing control of annual fires, the forests and woods of this whole region [northwest California] are showing a decidedly aggressive character and are encroaching steadily on the barren lands. There is today more wooded area in Humboldt County than when the white man came over half a century since.

There is little doubt that, prior to the historic era, many of the Indian groups in California utilized fire in conjunction with subsistence activities. Henry Lewis (1973:1-101) has presented an overview of Indian burning practices in California. In addition, other researchers have reported that burning was practiced for various reasons by many Indian groups throughout North America [for a good overview see Pyne (1982:71-83)].

In a later study, Lewis (1983:75-85) discusses the current burning practices of the aboriginals of Australia. He notes that among those aboriginal groups still depending on the environment for traditional food resources, burning is used to improve habitat and to maintain diversity (Lewis 1983:79). It is not, he points out, a fire management program, but rather a hunting-gathering management program. Ethnographic analogy suggests that burning was used within the North Fork basin for similar reasons. Within the basin much of the oak woodlands is the seral (intermediate succession) stage for Douglas-fir climax forest. By preventing the establishment of the climax vegetation community (suppressing the climax stage of growth) and maintaining grassland and oak woodland vegetation communities, the aboriginal groups inhabiting the North Fork region "managed" the environment to promote species habitat and diversity. By consciously manipulating their environment, local groups maximized the availability of the resources they utilized for their subsistence.

As Lewis (1983:75) points out:

> ...to successfully forage for plants and animals, people must understand the seasonal availability and regional distribution of the plant species used by them as well as those consumed by the animals they hunt. They must also understand the life histories and adaptive strategies of the resource animals hunted and the predators with which they compete. Thus, for a people to depend upon a few, mechanically simple tools to obtain a livelihood, they must have a broadly based and detailed knowledge of the environment they exploit.

While limited ethnographic data exist for the Wailaki and Lassik, who inhabited the region, there are a few references to burning. Nevertheless, it is likely that the burning practices among the other southern Athabascan groups and the neighboring Yuki were similar. Essene (1942:55) writes that the Lassik (who occupied the northern part of the North Fork basin) regularly used fire to keep their territory clear of undergrowth so that it would be easier to hunt and travel. One of his informants indicated that much of Trinity County was open prairie prior to the historic period.

There was a number of other reasons that burning took place: to drive deer (Goddard 1923a:122), to collect grasshoppers (Curtis 1924:25), and to suppress undergrowth and remove litter in order to prevent disease and facilitate the future collecting of acorns (Interview 395). Burning was also used to improve the quality of basketry materials by encouraging the growth of young pliable shoots. In addition, areas around permanent village sites were often burned to protect them from being consumed in uncontrolled fires (personal communication, Kathy Heffner-McClellen, Anthropologist, USDA Forest Service).

One elderly consultant from the North Fork area (Interview 395) noted that, when he was young, there was very little brush in the area, but by the time he had finished his schooling, small pine and Douglas-fir were scattered all through the larger trees. He blamed this on the lack of fire. He also said that when he was young, he was told that much of the area was open because the Indians had burned it; he was also told that to keep fires from getting too hot and causing damage, the Indians would start fires on the ridges and try to make them burn downhill. Another consultant, from Potter Valley, said that his father, who had moved to the area in the late 1800s, had told him that the Indians of that area would burn one side of the valley one year and the other side the following year.

Fire and Its Effects on Vegetation in the North Fork Basin

Mature oaks are well adapted to survive ground fire (Barbour and Major 1977:409) and oak shoots will sprout from trees that are burned and will regenerate quickly (Photograph 1). While the thick bark of mature Douglas-fir helps protect these trees from fire, young fir trees are very sensitive to fire. The Travis Fire, which occurred within the North Fork basin in September 1987, illustrates this point. Many of the pole-sized and younger stands of Douglas-fir were destroyed. Moreover, some mature stands of saw-timber in which the fire crowned were also destroyed. The high intensity fire within mature stands of Douglas-fir was the consequence of a fuels build-up resulting from a lack of the more frequent and low intensity burns which took place prior to the historic period (Photograph 2). Within those areas where the oak woodlands continued to predominate and fuel loads remained light, the fire did little to damage to the overstory (Photograph 3).

In 1990, three years after the fire on a visit to some formerly forested areas, it was noted that all of the Douglas-fir were dead and no seedlings were yet established. In many of these former Douglas-fir stands were the charred remains of white oaks and black oaks (Photograph 1). These trees had sprouted at their bases and some sprouts were over 3 feet high. If no human intervention takes place (i.e., the planting of conifer seedlings by the Forest Service), this area will again become an oak woodland (and, of course, if it has the potential and no fires occur, will eventually through succession, again become Douglas-fir forest).

During the historic period, the North Fork basin was used by ranchers to graze livestock. First cattle and later sheep were found in great numbers in the North Fork region (Herbert et al. n.d.:77). Overgrazing led to a general degradation of rangelands including increased erosion and loss of native grass and forb species. It is well known that during this period, burning was used by local ranchers on the

Photograph 1: *The Travis Fire occurred late in the summer of 1987. In the spring of 1988, young shoots were already sprouting from the base of the oaks. In this particular area most of the oaks were dead or dying prior to the fire. Mortality for Douglas-fir in this area was almost 100 percent. If no Douglas-fir are planted, the oak woodlands vegetation association will again dominate this area.*

Photograph 2: *During the 1987 Travis Fire, fuels buildup from lack of periodic fires led to high intensity burning and complete stand replacement on the western slopes of Jones Ridge (background). Fires in dense brushfields (foreground) burn at especially high temperatures.*

Photograph 3: *During the Travis Fire of 1987 only the light fuels, mostly grasses and herbs, burned in oak woodland areas. With no ladder fuels the fire did little damage to the overstory in these areas.*

rangelands to try to keep the land open for grazing. Much of the rangelands (open savannas and oak woodlands), however, were so badly overgrazed that they contained very little vegetation (Photograph 4). Because of this break in the continuity of light fuels, fires did not easily spread across wide areas of the landscape (Arno and Gruell 1986:275, Covington and Sackett 1986:452, Interview 449). In addition, burning usually took place in late fall, when the livestock were brought down from their summer range. One consultant (Interview 449) indicated that usually the fires were not started until after the first snows in the high country necessitated the moving of stock to the winter ranges. Because it was somewhat later in the year than the Indians burned, and also because most of the light fuels had been removed by overgrazing, one consultant (Interview PCWA#2) remembered that "most of these fires didn't do much—they 'squirreled around' but did not burn hot." Therefore, the burning that took place during this period was neither sufficiently widespread nor of an intensity to suppress the vigorous growth and expansion of Douglas-fir.

Since April 26, 1905, when much of this region came under the jurisdiction of the U.S. Forest Service, most burning has been illegal on public lands. Wildland fires that have occurred within the North Fork basin since this date have been suppressed as soon as possible, regardless of cause. The emphasis has been to encourage the growth of forests for timber management and harvesting. The ethnographer Edward Curtis (1924:25) wrote that:

> one of the sorest grievances of northern California Indians, as well as many of the white men, is that the Forest Service will not permit the burning of mountainsides. Indians declare that they cannot follow deer and white men note that they cannot graze cattle, because of the impenetrable thickets.

Interview data and homestead records indicate that while occasional uncontrolled fires occurred within the North Fork basin after 1905, they have been neither common nor widespread, and since that time, brush and understory have increased dramatically (Interviews 395, 391).

The evidence presented in this section indicates that during the prehistoric period, fire played an important role in determining the distribution of plant communities found in the region. Conversely, since the beginning of the historic period, the lack of fire has played a role in facilitating many of the changes in the environment that have taken place within the North Fork of the Eel River basin.

Photograph 4: *Evidence of overgrazing in 1919 on the California (now Mendocino) National Forest. In addition to causing increased erosion, overgrazing reduced the amount of light fuels available, thus reducing the ability of fire to spread rapidly through the environment.*

Chapter 3

Documenting Changes in the Extent and Distribution of Vegetation Associations within the North Fork Basin

After having noted in the last chapter that changes have occurred in the extent and distribution of Douglas-fir and Oregon Oak Forest communities within the North Fork basin since the beginning of the historic period, the question remains: how much change has taken place? This section classifies by vegetation type the amount and the kinds of changes that have taken place during this time.

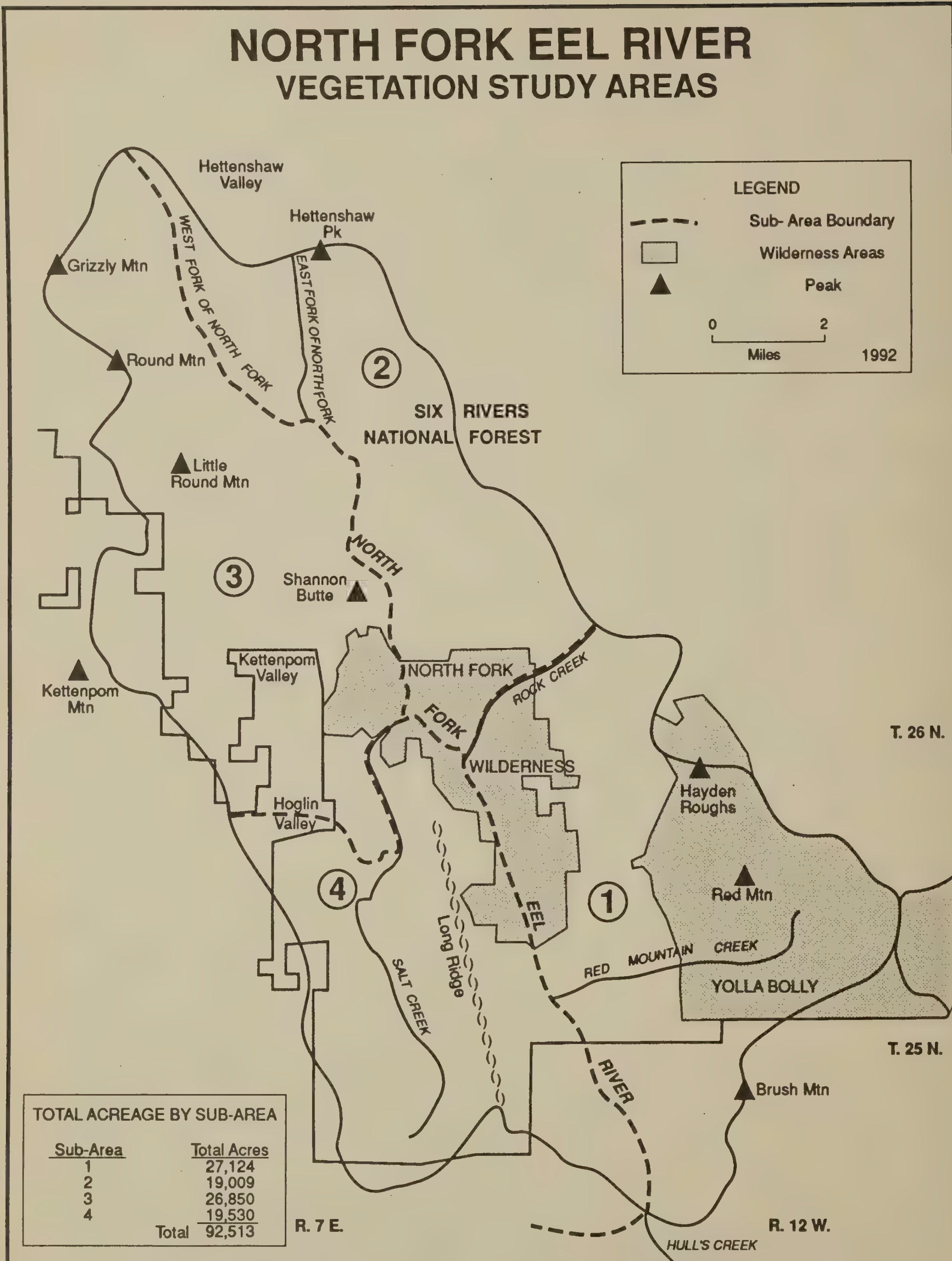
The area selected for study was the portion of the North Fork drainage north of where Hull's Creek meets the North Fork of the Eel River (see Maps 1 and 2). This area was chosen for study because it consists primarily of public lands, and even today is remote and relatively undeveloped in comparison with other drainages in the region (there is still no bridge over the North Fork for 35 miles above the county road). The research area is approximately 92,000 acres in size and makes up about 60 percent of the total area of the basin.

Classifying and Quantifying Vegetation Types

Changes in the extent and distribution of vegetation were quantified through the use of a system of "polygons" developed by the Land Management Planning Department of the Forest Service, which classifies and maps vegetation distributions on a series of topographical maps. The irregularly shaped areas vary in size from about 2 to 250 acres. Most, however, average about 20 to 40 acres. For example, the Long Ridge 7.5 minute U.S. Geological Survey map is divided into 1,098 polygons, and the entire research area contains approximately 5,000 polygons.

For each polygon, specific information is recorded in a database about that unit of land. For forested areas, the timber type and relative age are generated through aerial photographs that delineate crown closure, tree type, and stand density. Under this system, Douglas-fir stands can be classified as seedlings and saplings, pole timber, saw timber, large saw timber (mature), and large old-growth.

For this study, polygons were further classified by on-the-ground surveys that recorded such characteristics as the presence or absence of dead or dying oak under the closed canopies of the stands of Douglas-fir, subdominant species of vegetation, and other vegetation characteristics. Vegetation type was then recorded by polygon for both the years 1985 and 1865. The year 1985 was established as the baseline for entering current vegetation associations (the year the study began), and the year 1865 was selected as the historic baseline date. The year



Map 2, North Fork Eel River Vegetation Study Areas

1865 was chosen because it marked the point at which there was a major shift in the land-use activities in the region. Until 1864 some of the local Lassik and Wailaki continued to inhabit the North Fork basin and maintain a semblance of traditional subsistence activities. In the fall of that year, the surviving Indians in the region were removed to the Round Valley Indian Reservation (Keter 1990:15).

Private lands within the research area were classified, and these data were also entered on the polygon maps and into the database. These polygons for private lands are somewhat larger than those for public lands but are also based on classifying lands according to vegetation types.

U.S. Geological Survey and polygon maps were carried in the field, and each unit of land was classified during the course of archaeological surveys. The presence of factors indicating a previous oak woodland area or evidence that grasslands (locally referred to as glades) had been invaded by trees were noted along with the current vegetation type. Also noted was whether the stands of Douglas-fir were comprised of old-growth, mature, pole-sized or younger even-aged trees. These data were then compared with the polygon database for the respective unit of land to confirm the relative accuracy of the vegetation description. Next, the data were entered on a spreadsheet; for each polygon a vegetation description for 1985 (the base year of the study) was recorded. From the field data, each polygon was then assigned a vegetation classification for the year 1865 on the basis of the assumptions outlined in the next several sections.

Vegetation Classification Categories

The major vegetation classifications are presented below. These classifications were further subdivided to denote associated species and, in the case of Douglas-fir, to denote old-growth, mature, and immature stands of trees. For example, a polygon consisting of oak woodland with small Douglas-fir invading the stand, but not yet over-growing the oak, would be classified as oak-woodland, with small Douglas-fir understory. An oak stand with manzanita and other brush species as an understory would be classified as oak-woodland, with brush species or xeric vegetation component. In this way, a finer distinction could be made between vegetation types. (See Appendix 1 for a complete listing of vegetation types).

The major vegetation classification categories are as follows:

Brushlands	Areas of brush, xeric aspects with limited vegetation, areas of poor soils
Mixed Conifer	Areas where conifer species other than Douglas-fir predominate (uncommon)
Grasslands	Areas where grasslands predominate (savanna, oak savanna)
Riparian	Areas of streamside vegetation (willow, alder)
Oak Woodland	Areas where subdominant associates include Douglas-fir and ponderosa pine
Douglas-fir	Fir predominate and are invading and/or overgrowing oak woodlands
Established fir stands	Douglas-fir stands >120 years of age, baseline 1985

Assumptions in Classifying Vegetation Types

As noted elsewhere in this study, a number of factors have influenced changes to the environment within the North Fork basin since 1865. These factors include:

- Cessation of intensive burning by aboriginal groups
- Intensive grazing and over-grazing by livestock and feral pigs
- Historic patterns of settlement
- Emphasis on commercial timber growth and the exploitation of timber resources
- Suppression of wildland fires since 1905 when the Forest Service took over management of this region.

For this study, the most relevant information consists of the acreage and ages of conifer stands in comparison with those of grasslands and oak woodland areas. During on-the-ground surveys, a number of indicators, as discussed below, permitted classification of the vegetation for 1865.

It is obvious, even to the casual observer, that the oak woodlands and the Douglas-fir within the basin have undergone profound changes in distribution since 1865. These changes are relatively easy to quantify in the field. Within the even-aged stands of Douglas-fir that have overgrown the oaks, one can invariably find several old-growth Douglas-fir. These trees have large lower radiating branches, evidence that they grew in a more open environment with little intra-species competition. After cessation of burning, these trees became the seed source for today's even-aged stands. The oaks provided shade that conserved the moisture content of the top layer of soils, allowing the Douglas-fir seedlings to become established. When the Douglas-fir grew above the oaks and shaded them out, the oaks began to die (Photograph 5). It should also be noted that within many of the young Douglas-fir stands there are a few old-growth ponderosa pine. These trees are not shade-tolerant and cannot become established under a dense canopy. They provide additional evidence that a particular area was more open prior to 1865.

In the research area, most of the private lands were acquired under the Forest Homestead Act of 1906 and the National Forest Indian Allotment Act of 1910. One of the stipulations of both Acts was that the land be of agricultural value and contain no stands of commercial timber. Forest Service files (Supervisor's Office, Eureka) contain a majority of the homestead applications for this area, complete with a verbal description of the vegetation and a color-coded map of the vegetation types and their distributions on each 160-acre parcel. It is clear from these reports that the parcels contained almost no conifer stands. There may have been some stands of immature Douglas-fir invading oak woodland areas as evidenced by the recently logged early mature stands (under 100-120 years old) on some areas of the private property.

It should also be noted that many of the original land surveys conducted in the late 19th century by the General Land Office (GLO) used oak trees as bearing or corner markers. Recent land surveys have found many of these trees dead or dying within stands of Douglas-fir (personal communication, Larry Walter, Land Surveyor, USDA Forest Service).

While conifer stands and the oak woodlands were relatively easy to classify, other vegetation associations were more problematic. For example, throughout the North Fork basin there are areas of serpentine soils, laterite soils (mostly in the Red Mountain area), and exposed rock or shallow soils (called "roughs" locally) with their own unique vegetation associations. These associations were considered to have changed little over time because soil type is a limiting factor and many of these areas are on south facing slopes. It is likely, however, that vegetation

Photograph 5: *Dead white oak snag in an even-aged stand of Douglas-fir approximately 80 years old. Note the heavy fuel load of dead limbs and ground debris.*

growth is somewhat more dense today because of lack of fire.

These areas appear to have unique vegetation communities that probably existed prior to 1865. In some locations, however, invasion of brushy areas by Douglas-fir took place. For example, in the Lousy Creek drainage some Douglas-fir had invaded an area that was formerly comprised of manzanita; the manzanita were dead and in the process of decaying because of the lack of sunlight under the even-aged fir canopy. [In this area, manzanita is an early seral invader known to dominate on sites after hot burning fires (personal communication, Thomas Jimerson, Ecologist, USDA Forest Service).]

Although the species composition has changed dramatically since 1865, it appears that over much of the basin, the savanna grasslands and oak savanna (where the number of oaks per acre is very low) have been resistant to the invasion of Douglas-fir. The reason for this stability is that the grasslands rapidly reduce moisture content in the soils near the surface (the opposite effect is true for deeper soils), preventing the establishment of Douglas-fir seedlings. In this region, availability of soil moisture rather than the amount of precipitation, nutrients, light, or temperature is the primary component of forest formation (Barbour and Major 1977:367). [It should also be noted that in this region some oak woodland and oak savanna sites have shallow skeletal soils that are not suitable for the establishment of Douglas-fir. In these areas, stands of white oak are the potential climax vegetation type (personal communication, Tom Jimerson, Ecologist, USDA Forest Service).]

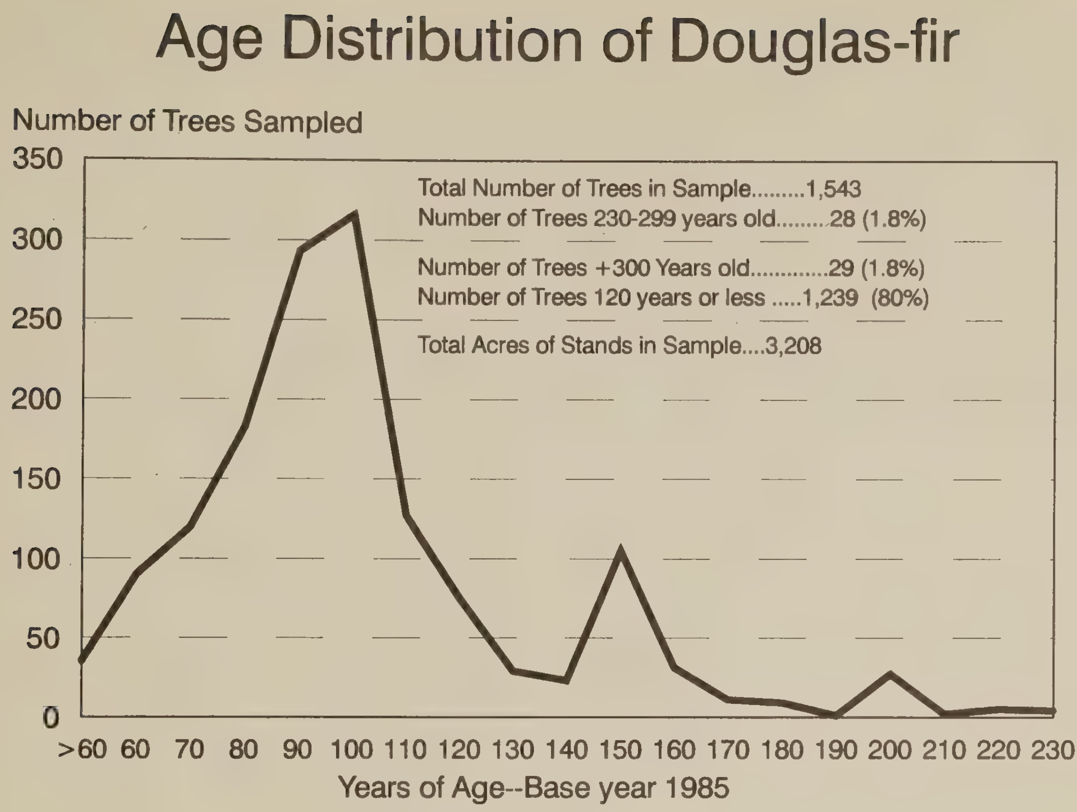
Evidence of the importance of soil moisture to Douglas-fir growth can be seen on some of the local private lands, where pole-sized timber that invaded the oak woodlands has already been harvested. In these areas, Douglas-fir have a low rate of natural regeneration despite adequate soils. With no oak canopy (it died out during the crown closure of the Douglas-fir) to conserve soil moisture in the top 8-12 inches of soils, grasses are now predominating, with some oak regeneration from the base of some of the older trees that survived under the fir canopy.

Age Classification of Douglas-fir

To ensure that the succession of Douglas-fir within the oak woodlands, as discussed in the previous section, occurred after 1865 and that other unknown factors (such as climate) did not incite conifer invasion prior to this date, I examined data compiled by Forest Service silviculturalists on the age of potential timber harvest units. Age data on Douglas-fir were examined for three timber sales totaling 1,543 trees within 3,208 acres of timber harvest units located in the research area. Graph 1 clearly demonstrates that the majority of Douglas-fir stands have become established since 1865 (trees were selected for coring in order to determine the average age of a timber harvest unit). Of all stands examined, 80 percent were 120 years old or less.

Most of the even-aged stands of Douglas-fir encountered during field surveys were of the same diameter as those stands with age data (usually about 18-24 inches in diameter). Many stands classified during the on-the-ground surveys were even younger, some 20-50 years old or less. Estimates for younger trees (<25 years) were made by counting whorls (a method used by foresters to estimate the ages of young trees). In many instances, the stands of younger trees are still under the oak canopy and have not yet begun to shade out and kill the oaks.

An example of young Douglas-fir invading an oak woodland area can be observed on the Russ Homestead (CA-TRI-1000/H). (Most homesteads in this area were abandoned and bought up by a local timber company and are now in the hands of one land holder, a local rancher, or were traded back to the Forest Service). The Russ homestead was not abandoned until the 1930's. Here, the Douglas-fir are very young; most are less than fifty years old and



Graph 1: *Age Distribution of Douglas-fir*

are crowding in around the cabin area. Clearly, these trees have become established since the homestead was abandoned.

It was, in fact, impossible to find *any* stands of Douglas-fir displaying old-growth characteristics within the research area. Old-growth forests are complex and it is often difficult to differentiate them from other stands based on one or two stand structure attributes. In general terms, old-growth Douglas-fir forests are defined as containing a wide range of sizes and ages (including large-diameter trees), a multi-layered canopy, and substantial woody debris in the form of standing snags and logs decomposing on the ground (Bruebaker 1991:18, Jimerson et al. 1991:2). [For more detailed data on the classification and definition of old-growth Douglas-fir forests in the North Fork basin and adjacent region see Jimerson et al. 1991.]

Within the North Fork basin, some mature stands exceeding 200 years of age were noted—for example, on the north slopes of Russ Mountain and portions of Packwood Flat. For the most part these mature stands were opportunistic and had probably become established as chance and burning patterns permitted (in areas of topographical shading, for example). To date, no stands displaying the characteristics of an old-growth Douglas-fir forest have been recorded.

Vegetation Study, Results, and Conclusions

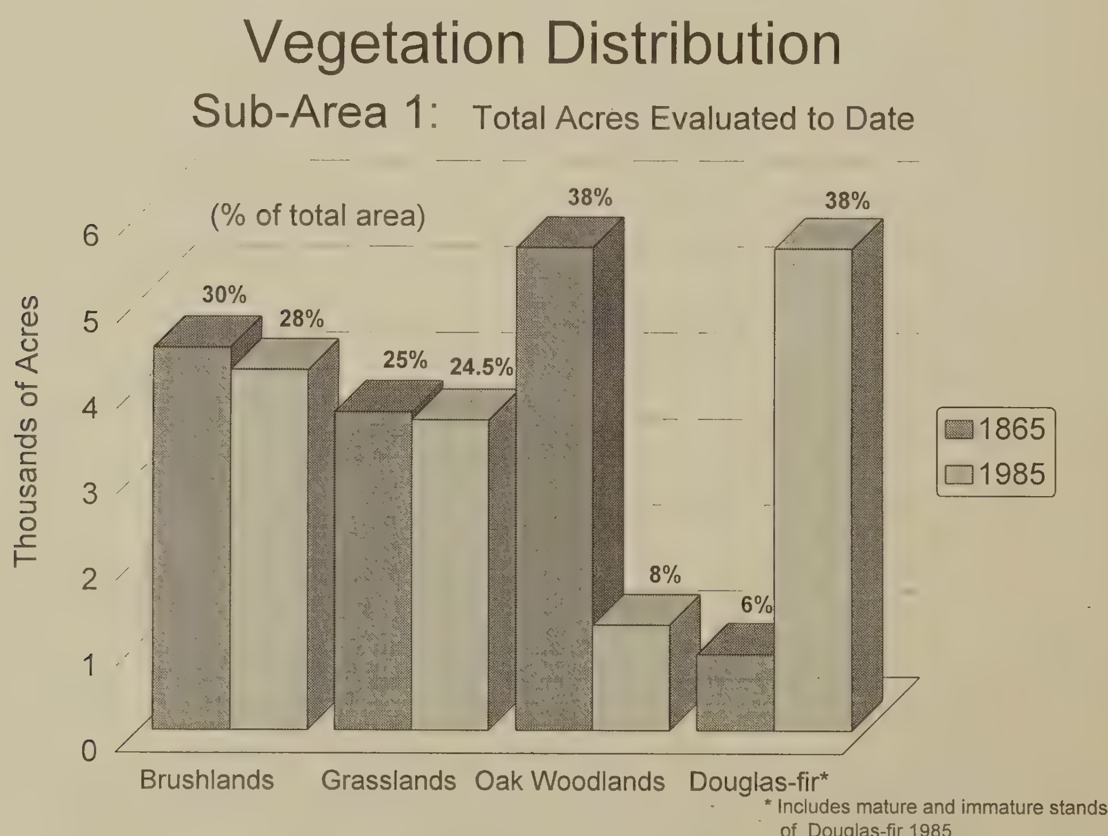
At this time approximately 23,000 acres within the research area have been classified by vegetation type in accordance with the base years of 1865 and 1985. The research area has been divided into four sub-areas (see Map 2), and surveys have been conducted in each sub-area. Table 1 presents the total acres covered to date within each sub-area.

Table 1. Acres Surveyed in each Sub-Area (See Map 2)

Sub-Area	Acres Surveyed	Total Acres of Sub-Area
1	15,073	27,124
2	2,629	19,009
3	2,690	26,850
4	3,017	19,530
Totals	23,409	92,513

The following discussion is limited to the results of the vegetation surveys in sub-area 1 because this sub-area has been the most completely surveyed—about 55 percent of its area. Sub-area 1 is located to the east of the North Fork and to the south of Rock Creek (see Map 2) and contains about 27,100 acres. Of this total, approximately 19,000 acres are Forest Service lands, 1,100 acres are Bureau of Land Management (BLM) lands, and 7,000 acres are private lands.

Survey results (see Graph 2) suggest that major changes in the extent and distribution of the oak woodlands and Douglas-fir forests have occurred during the last 120 years. On the lands surveyed to date, there has been a six-fold increase in the area of



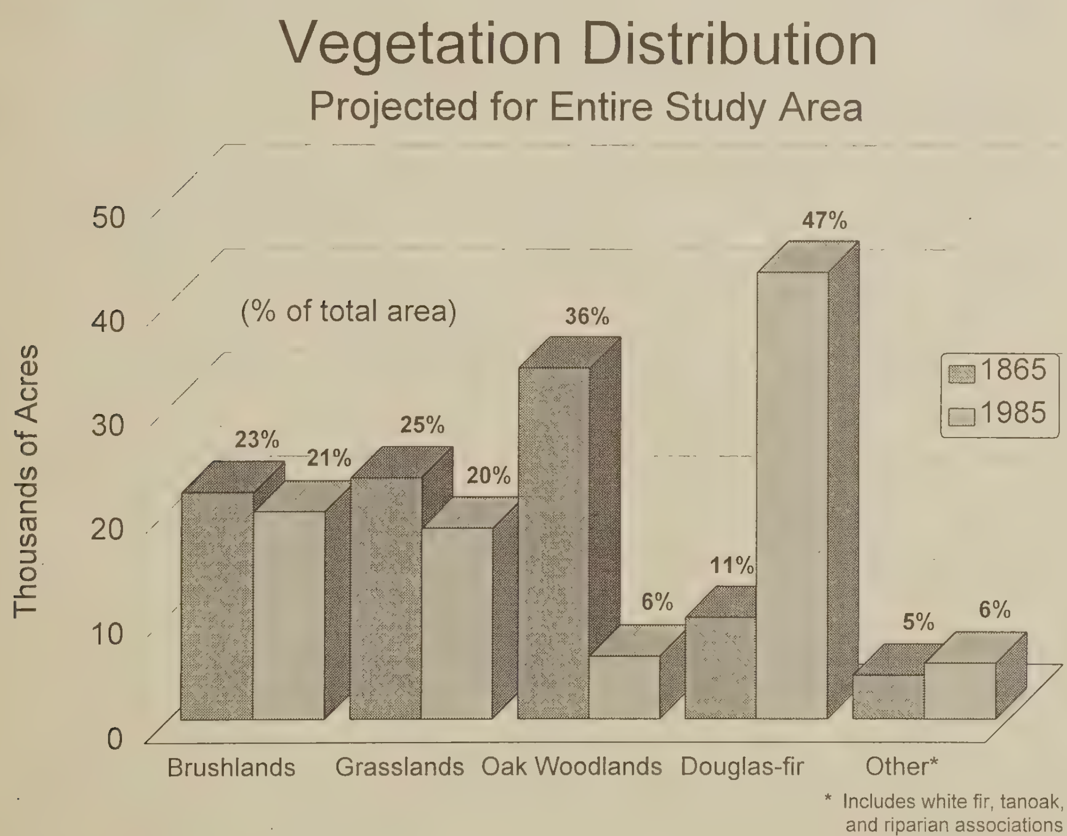
Graph 2: *Vegetation Distribution, Sub-Area 1*

Douglas-fir forest, from 1,051 acres to 6,276 acres. There has been a corresponding and dramatic reduction in the oak woodlands vegetation type, from 6,005 acres in 1865 to only 1,139 acres in 1985. The other vegetation types, the grasslands and brush lands, have remained relatively stable, with some minor reductions (less than 2 percent) being lost to invasion by Douglas-fir (Photograph 6). The limited areas of riparian vegetation are not yet reflected for sub-area 1 and no tanoaks (*Lithocarpus densiflorus*) are found in this area. For these reasons, no vegetation category labeled "other" is shown for Graph 2.

Using the land management polygon database for the entire research area and the empirical data cited above for sub-area 1, I then projected vegetation association distributions for the entire research area. This projection was accomplished by comparing the 1985 vegetation types recorded in sub-area 1 for this study with the corresponding data from the polygon database. Vegetation associations were then projected for the entire basin on the basis of percentages of the land base occupied by each vegetation type in the land management polygon database. Graph 3 presents these data. The results for the research area as a whole are similar to those for sub-area 1 and demonstrate that significant changes have occurred to the vegetation associations of the entire area since about 1865.

A cursory survey of the remaining portions of the North Fork basin outside the research area (the Hull's Creek drainage and the lower portion of the North Fork drainage) suggests that similar changes to distributions of vegetation types occurred there, although the increase in Douglas-fir is probably not quite as large.

These changes in the extent and distribution of vegetation communities have had a profound influence on the entire ecosystem of the basin. For example, the reduction in the extent of the oak woodlands has also reduced the habitat for various animal populations including deer. Based on the analysis of historic vegetation distributions, it can be concluded that the Indian people of this region inhabited an environment very different from that which exits today.



Graph 3: *Vegetation Distribution Projected for Entire Study Area*

Photograph 6: *View west near the head of Rock Creek. Three of the basic vegetation associations found within the North Fork Basin. Open savanna (foreground), oak woodlands (middle ground), and Douglas-fir forest (background). Note the young Douglas-fir invading the oak woodland stands.*

Chapter 4
Grasslands of the North Fork Basin

Since the beginning of the historic period, one of the most dramatic (yet least understood and documented) changes to the vegetation communities of California has occurred through the introduction of exotic plant species into the grasslands and oak woodlands. Within these vegetation types, exotic species have almost completely replaced the native grasses. These changes were due not only to the migration of exotic species of plant life or their being imported into the region by farmers and ranchers, but also as a result of the change in land-use practices from the prehistoric era to the historic period.

Within the North Fork basin, the grasses and associated herbaceous plants found within the grassland (savanna) and oak grassland (oak savanna) vegetation communities provided important food resources for both humans and wildlife. While the areal extent and distribution of the oak woodlands has changed greatly during the last century, even more dramatic are the changes that have occurred in the composition of the grass and forb species associated with the grasslands. These changes affecting the grasslands also occurred to the grass and forb species found in the surviving oak woodlands since they are structurally similar although not identical. While no exotic tree species have become established within the basin, a large number of non-native grasses and forbs now dominates the grasslands.

The vegetation studies discussed previously indicate that approximately 23,000 acres (25 percent) of the research area were grasslands (savanna, oak savanna) in 1865. Today, that figure is approximately 18,000 acres (20 percent) (see Graph 3). Vegetation surveys indicate that only in the northwest portion of the basin (mostly above 4,000 feet), and on some of the east- and north-facing slopes (areas of topographical shading) has there been much encroachment by Douglas-fir into the grasslands.

Today, grasslands within the North Fork region, like those throughout much of California, are dominated by annual grasses. The majority of these plant species is non-native (Burcham 1981:173). In the Yolla Bolly country, few native perennials are evident in the rangelands (personal communication, Janice Stevenson, Wildlife Biologist, USDA Forest Service). Native species of grasses and forbs could no longer compete with the introduced species. This replacement of native forbs and grasses occurred so suddenly and completely that there is little documentation of the grassland associations existing prior to the historic period (Heady 1977:493).

Grasses and Forbs in the Oak Woodlands

Oak woodlands, like the grasslands (and oak savannas that are on a continuum between the two), also contain grasses, forbs, and other important plant species used by aboriginal populations. This vegetation type, as noted earlier, has been dramatically reduced in extent and distribution within the North Fork basin, affecting both plant and animal populations and their distributions.

The oak woodlands can be placed on a continuum somewhere between grasslands and montane forests. Because of their capacity to produce acorns as well as grass, bulb, and forb resources, they were the most productive vegetation association within the North Fork basin for both humans and many wildlife species.

Saenz (1983:7) notes that oak canopies "can alter the environment beneath the trees[,] resulting in changes in the distribution and abundance of species compared to surrounding open areas through a variety of positive and negative feedback systems." Vegetation related to oak trees can be affected by the alteration of soil properties through decomposition of leaf matter (creating higher humus content than the surrounding soil) and soil-temperature differences. Interception of sunlight by the leaf canopy can also affect temperature, humidity, and soil moisture content and alter the amount of radiation that the ground receives (Saenz 1983:8).

A recent study in an oak woodland area of northern Humboldt County where white oak dominates, as it does in the North Fork basin, indicated that there is "a marked difference in species composition between grasslands and oak woodlands" (Saenz 1983:28). Davy (1902:27) noted an example of this at the turn of the century, when he found *Trifolium sorpiodes* (now called *T. eriocéphalum*) growing for the most part under the shade or partial shade of oak trees. In the Saenz study, 30 species of plants were common to both grasslands and oak woodlands. In addition, heavy grazing altered the species mix, and different plants dominated under these conditions. Another conclusion of the Saenz study with implications for the North Fork basin is that perennial species of grasses and forbs predominate in the oak woodlands, even if they have been heavily grazed by today's standards. In grassland areas, however, annuals predominated in both lightly and heavily grazed areas (Saenz 1983:32). Furthermore, species diversity was found to be greater in ungrazed areas. Finally, the Saenz study concludes that introduced species of grasses outnumber native species in both grassland and oak woodland areas, while the number of native forbs is greater in all areas except the most heavily grazed grasslands, where they are equal.

For the reasons outlined above, the oak woodland and grassland vegetation types provided a resource-rich environment for both wildlife and humans. Because of the shading properties of oak canopies and the resulting conservation of soil moisture, grasses and forbs in these areas would have extended their growing seasons (there would also have been some variation in species composition). This conservation of moisture (reducing evaporation near the surface) under the oak canopy can still be seen today in the late spring. When the grasslands have already matured and turned gold, the grasses (and associated clovers, bulbous plants, and other forbs) under the oak canopy remain green for about 2 to 3 weeks longer. This prolongation would have resulted in the extended availability of certain food resources for wildlife and humans.

Historic Background

The first non-native plant species were probably brought into California by the Spanish as early as the 18th century (Burcham 1981:1). Most of these early species were related to farming and were not a major factor in the replacement of native species. The plants that began to replace native vegetation were for the most part introduced unintentionally (see Appendix II, Tables II-A and II-C for a complete listing of native and non-native grasses found within the basin). Most were undesirable as forage

and entered the state in the coats of animals, in packing materials, ballast for ships, and impurities in crops and grain supplies (Burcham 1981:173). Because they are adapted for dissemination by the wind and by birds and other animals, exotic grasses and forbs often preceded the colonizing of an area.

For example, three species—curly dock (*Rumex crispus*), alfilerilla (also called red-stemmed filare, *Erodium cicutarium*), and prickly snow thistle (*Sonchus asper*)—were probably established in northern California prior to colonization in 1769 (Burcham 1981:173). It appears likely that the Russian colony settling at Fort Ross in 1812 was the first to introduce wild oats (*Avena fatua*) and a number of other non-native plant species to areas north of San Francisco. By 1833, wild oats and mustard (*Brassica campestris*) were noted as growing in abundance in the area. During the expedition of Redick McKee in 1851, it was noted that wild oats were common north of the Sonoma settlements into the upper reaches of the Russian River valley. The McKee Party did not, however, observe any wild oats after they crossed into the Eel River drainage (Burcham 1981:175).

It is not known when the first exotic species were introduced into the North Fork region. However, it appears that some exotic species may have preceded historic settlement of the region. For example, wild oats appear to have been exploited by the Northern Pomo long before the settlement of northern Mendocino and Lake Counties (Chestnut 1974:31). Essene notes that it is believed that wild oats were established in the Round Valley region by about 1850. He (Essene 1942:55) indicated that some of his Round Valley informants believed that wild oats were native and were there before the ranchers and Army first entered the valley. Several early expeditions may have passed through the Round Valley area before 1850 (Carranco and Beard 1981:30-34), and some species of grasses and forbs may have been introduced at that time. It is also possible that propagation from the south occurred through such natural processes of dispersion as wind and animals.

In the late 1890s, Joseph Burtt Davy made several trips to the North Coast Ranges to document range conditions and survey the species of grasses and forbs. One of these trips included discussions with long-time residents and field trips to southeastern Humboldt County and northern Mendocino County. In 1902 he published *Stock Ranges of Northwestern California* (Davy 1902), and this reference remains the most comprehensive overview of the early grasslands of the North Coast Ranges. The following discussion of grasses within the North Fork basin is based primarily on Davy's survey. It outlines what can be reconstructed of the changes that have taken place in the grasslands during the historic period. The North Fork basin is located less than 5 air miles from some of the areas that Davy visited in the field. It is likely that the rangelands were similar in species composition and that they were identical in historic land-use patterns.

The Ethnographic Period

Prior to the Contact Period, the local Indian populations had some effect on species composition of the grasslands through such land-use practices as seed gathering and seasonal burning. Fire can alter competitive relationships among various plant species. Moreover, variations in fire frequency can also change vegetative composition (Ohr and Bragg 1985:113). Therefore, it is likely that prehistoric land-use practices had altered the species composition of the grasslands from what might be considered a "pristine" (no human influence) environment. This conclusion supports the view that aboriginal groups had a significant influence on their environment and on the ecological processes taking place within their territories. In addition, the exploitation of plant resources by wildlife may also have influenced the species mix of the grasslands. It is probable, however, that a dynamic equilibrium had been achieved over time and that the vegetation associations of the grasslands were relatively stable.

The dominating grasses were perennial bunch grasses including species of *Danthonia*, *Stipa*, *Melica*, *Poa*, and *Festuca* (see Appendix II Table II-A). It is quite possible that California oat grass (*Danthonia californica*) may have been the predominate grass species within the basin and much of the

North Coast Ranges. Davy (1902:26-27) notes that *Danthonia* was considered excellent forage, but that by the time of his study in the late 1890s it was uncommon, especially within the region to the east of the Eel River (this would include the North Fork basin). Common forbs would have included wild pea (*Lathyrus* spp.), perennial and annual clovers (*Trifolium* spp.), and wild sunflowers (*Whethia* spp.) (Davy 1902:38). In addition, bulbous plants including *Camassia leichtlin* (referred to locally by its Indian name *ketten*) were common in many areas of the North Fork basin including Kettenpom and Hoaglin Valleys. A number of other important plant species exploited for food (refer to Appendix II) as well as other uses, such as basket making, are also associated with the grasslands and oak woodlands.

1854-1865: Conflict and Settlement Period

It appears that replacement of native perennials by introduced annuals occurred in stages as historic development took place (Davy 1902:36, Heady 1977:493). One researcher, J. E. Perkins, noted in 1864 that:

> less than ten years ago, the traveler [in the grasslands of northern California] would ride for days through wild oats tall enough to tie across his saddle, now dwindled down to stunted growth six to ten inches with wide reaches of utterly barren land (quoted by Heady 1977:497).

While some changes to the grasslands of northern California may have begun during the Spanish era, they were greatly accelerated after 1855. As noted earlier, it appears that the first exotic species to become established within the North Fork basin may have been wild oats and possibly red stemmed filaree (*Erodium cictarium*). They may actually have become established prior to the Conflict and Settlement Period (Davy 1902:38). With the introduction of livestock and feral pigs into the region after 1865, perennial species began to decline and native annuals increased in number. The rapid growth of the livestock industry toward the end of this period (especially to the south at Round Valley) led to an increase in the number and predominance of exotic species and accelerated the decrease in native perennials and annuals. During this period, disturbance of the environment by feral pigs also contributed to the decline of native grasses and affected bulbs, clovers, acorns, and other plant resources that the local Indian populations depended upon. The result was widespread hunger and even starvation among the Wailaki and Lassik (Keter 1990:18).

1865-1905: Ranching Period

By January 1865, with the removal of the last Wailaki and Lassik who had avoided being killed or captured during the "Indian Wars," the North Fork of the Eel region was no longer considered too dangerous for settlement and livestock grazing (Bledsoe 1885:209). During the latter part of the 1860s, cattle herds from ranches to the west of the North Fork basin and to the south in Round Valley began to use the region for seasonal grazing. Because of favorable economic conditions (a tariff had been placed on imported wool during the Civil War), however, ranchers increasingly began to run sheep on the ranges of the Yolla Bolly country. By the early 1870s, sheep had almost totally replaced cattle on the rangelands in the North Fork region.

Although few large ranches were established within the North Fork basin, there were several ranches to the west on the main Eel River and to the south in Round Valley that utilized portions of the North Fork basin for grazing on a seasonal basis. The general pattern was for ranchers to use the North Fork region as transitional range during the spring, slowly moving their herds on "trailways" (a term used by locals to denote movement of stock through a much wider expanse of land than is inferred by the word trail) through the basin on the way to their summer ranges in the high Yolla Bolly Mountains and the South Fork Mountain region (Keter 1994:13). The bands of sheep (usually numbering about 1,500 to 2,500) might spend as long as 4 to 8 weeks slowly moving through the basin (Photograph 7). For example, the Ben Arthur Trail was the main route from the Arthur Ranch, located on the main Eel River to the south of Alderpoint, to the upper

Photograph 7: *This photograph was taken in October of 1916 on the California (now Mendocino) National Forest in the Snow Mountain area. This band of sheep numbers about 2,000 and is grazing in a recently burned area.*

Ruth Valley where Arthur's summer range was located (Keter 1994:24). It has been estimated that during the 1870s and 1880s as many as 40,000 to 60,000 sheep may have passed through the North Fork region each year (Keter 1994:24).

It was during the Ranching Period, when extensive grazing (and overgrazing) of the North Fork basin occurred, that the greatest changes to the grassland vegetation communities took place (c.f. Keter 1994). When interviewed by Davy (1902:35), one resident of Bell Springs in southeast Humboldt County noted that the species mix of the grasslands had changed several times during the 27 years that he had lived there. It is likely that overgrazing coupled with the continued introduction of exotic species were responsible for these on-going changes.

Davy (1902:21) interviewed one resident of Sherwood Valley (located about 40 air miles southwest of the North Fork basin) who entered the region in 1853. He indicated that California oat grass, a native perennial, was the most abundant plant in the grasslands at that time. By the 1890s California oat grass had disappeared from much of its earlier habitat (Chestnut 1974:311). After 40 years of intensive grazing this grass was difficult to find and had been replaced by exotic annuals and weedy species.

Small barley grass (*Hordeum* spp.) and soft chess (*Bromus mollis*) were introduced into the west Yolla Bolly country sometime after 1860, and *Festuca myuros* (locally called squirrel-tail or poverty grass) was brought in after 1865. One resident told Davy (1902:36) that he believed small barley grass had entered the area in the wool of sheep and was first observed along the trails leading into the region. [This is also noted to have occurred with Mediterranean barley (*Hordeum hystrix*) in the 1880s, see Chestnut (1974:313).] The early effects of settlement and grazing on the grasslands were followed by a second stage beginning about 1870 (during the boom years of the livestock industry). By this time, introduced annuals dominated the grasslands. By the mid-1870s when the numbers of cattle and sheep peaked in the Yolla Bolly country, the native perennials and annuals were becoming increasingly rare. The less palatable (and nutrient-poor) fox-tail and squirrel tail began to dominate the grasslands. While soft chess was even less palatable (although considered a more nutritious forage), it did not spread as rapidly across the ranges (Davy 1902:38). These exotic annuals were able to out-compete native grasses as well as wild oats.

The power of the large-scale ranchers actually began to wane in the early 1890s, and by the end of the Ranching Period in early 1905 the grasslands were depleted of most native species and the ranges were in extremely poor condition. At the time of Davy's study in the 1890s (1902:38), changes to the rangelands were still taking place. He noted that a type of alfilerilla (*Erodium circutarium*) and a number of grasses including brocho grass (*Bromus rigidus*), barley grass (*Hordeum marium*), and bur clover (*Medicago hispida*) were becoming the dominant species in the rangelands of the region. Davy also noted that while he did observe some native perennial bunch grasses, they were rare except in remote areas.

1905-Present: Homesteading Period and the Modern Era

During the Homesteading Period, small homesteads dotted the North Fork basin. Homesteaders grazed their livestock on their 160 acre parcels and adjacent National Forest lands. Grazing on National Forest lands was relatively unregulated until passage of the Taylor Grazing Act in 1934 (Photograph 8).

Today, the rangelands of the North Fork have recovered somewhat from the overgrazing of the Ranching Period. The carrying capacity of the rangelands is better understood, and the number of livestock grazing these lands is only a fraction of that in the boom times of the 1870s and 1880s. Evidence of overgrazing is, however, still visible, and one consultant (Interview 379) noted that Medusahead (*Elymus caput-medusa*) and tar weed (*Hemizonia* spp. probably *tracyi*), both considered noxious weeds, are still common within the North Fork basin. It is evident from Davy's account that

Photograph 8: *Prior to the Taylor Grazing Act of 1934, there were few attempts to regulate grazing on National Forest Lands. This photograph was taken at Three Prong Camp a high mountain meadow in the Yolla Bolly Mountains on the California (now Mendocino) National Forest in about 1914.*

these species have become increasingly dominant since the turn of the century. Also noted in field surveys was an apparent increase in wild oats since Davy's survey. Grass species noted within the North Fork basin during a recent botanical survey are identified in Appendix II, Tables II-A and II-C. During the excavation of an archaeological site by the Bureau of Land Management near Hull's Creek in 1991, another exotic species, yellow star thistle (*Centaurea solstitalis*) which is indicative of overgrazing and ground disturbance, was noted as pervasive on the site (personal observation). This species is common throughout much of the North Fork basin.

Today, there are few native perennials in the grasslands of the North Fork basin. Some native annuals can still be found. Introduced annuals, however, predominate. The next section outlines what is known of the causes for this dramatic change in the grasslands of the basin.

Domination of the California Grasslands by Non-native Species

It is not completely understood why introduced species of grasses and forbs came to dominate so completely the endemic species of the California grasslands nor which successional processes took place. One thing is clear, however, there are few, if any, other regions in the world where there has been such a rapid and complete replacement of native plant communities by introduced species (Burcham 1981:185). Burcham (1981:176) outlines a number of factors that are believed to have contributed to these changes:

- Composition of the original plant cover.
- Adaptations of the introduced species for dissemination and survival.
- Grazing and agricultural practices employed during development of the livestock industry.
- Climate of the California rangelands.

Severe impacts resulting from intensive grazing (which led to the reduction of ground cover) and the harmful effects of hoofed animals to the steep mountainsides increased erosion in the already highly erodible soils of the Franciscan formation. This erosion caused a number of problems in the region, including increased sediment loads to the creeks and rivers affecting the anadromous fishery. Grazing (and overgrazing) also severely damaged the habitat of the native grassland species.

The onset of grazing produces several effects in native vegetation. First, there is a change in the dynamic equilibrium of the native plant species with their environment (Burcham 1981:176). In California (including the North Fork basin), a high percentage of the native plant cover consisted of perennial bunch grasses and forbs. Preference by livestock for these palatable (and highly nutritious) plant species resulted in a rapid and drastic decrease in their occurrence. The initial result was probably an increase in the abundance of native annual species, which are more adapted to disturbance. They are also somewhat less palatable to livestock. In addition, annuals can pass the long dry summers in the seed stage, a characteristic that gives them a further advantage over perennials (Heady 1977:499). Perennial species also mature more slowly than annuals and must produce seed before grazing takes place. Although they may come back a second or even a third year, they will eventually die out if overgrazing continues (Chadwick 1989:77).

Continued overgrazing promoted conditions favorable to the next phase of plant succession in the grassland vegetation community—the establishment of non-native species, especially annuals. In addition to overgrazing, the successful invasion of grasses, predominately of European origin, required that the species be pre-adapted to the environmental conditions of the new region (Jackson 1985:349). Many of the introduced species came from areas with a Mediterranean climate similar to that of California. Over the centuries, they had adapted to lands heavily grazed by livestock (Burcham 1981:77).

In the Mediterranean basin, annual grasses are generally of minor importance, and perennials still dominate. Most grasslands, however, have been created through deforestation and are not true grasslands (Jackson 1985:357). For the reasons outlined above, it appears that many of the annual grass species introduced into California were pre-adapted to the highly disturbed range conditions in Europe and that the severe overgrazing in California facilitated their establishment. In effect, weed species came to dominate the California grasslands by easily adapting to and monopolizing overgrazed and bare ground (Davy 1902:42). And even with the cessation of overgrazing, the Mediterranean climate of California encouraged their dominance and reduced the possibility of successful competition by native perennials (Jackson 1985:357). Annuals may also have come to dominate the grasslands by depleting the moisture content of the soil before perennials reached their peak growth (Jackson 1985:359). Thus, it is possible that exotic species may also have had a significant impact on native grasses even if severe overgrazing had not taken place.

One other factor that might have significantly affected the grassland communities is the change in the fire regime since the end of the aboriginal period (Clark 1974:749). While fires occurred periodically during the historic period (prior to 1905), their season of year and the light fuel loads affected the environment differently from those of prehistoric times. It should also be noted that the introduced grasses tend to cure (dry out) earlier in the year than native grasses, especially the perennials (personal communication, Ron Masterogesipie, Ecologist, Redwood National Park).

The effects of fire on grasslands are not well understood and have not been thoroughly studied. Ohr and Bragg (1985) in Nebraska found that the effects of burning on grasslands are varied depending on fire frequency and recency. They found that soil nutrients, with the exception of phosphorous, were increased by burning and that the short-term effects of fire were to increase available plant nutrients. Although the authors did not study the long term effects of a cyclical fire pattern (similar to the regime of the North Fork basin) they suggested that nutrient uptake may affect long term changes in species composition (Ohr and Bragg 1895:113).

On the basis of past studies and current research, one can conclude that the primary reasons for the establishment and succession of introduced species of grasses that came to dominate the North Fork basin were the introduction of livestock and the overgrazing of the rangelands. As a conclusion to this section, it seems appropriate to quote Professor Harold Heady, who authored the section on grasslands in the *Terrestrial Vegetation of California* (Barbour and Major 1977:493):

> History has not recorded the vegetational dynamics of the pristine California prairie. After 25 [years] of studying this grassland, I believe that the plant succession tended toward perennial bunch grass dominants on nearly all well-drained upland sites, that numerous annual species were present, and that they dominated intermediate and low successional stages, just as they do in many other grasslands. Also, I believe that introduced annual plants prevent many perennial grasses from attaining their dominance, that annuals are now a large part of the climax on many sites (if not all), and that alien species should be considered as new and permanent members of the grasslands rather than as aliens. Their elimination from the California prairie is inconceivable.

Prehistoric Grasslands and Cultural Ecology

Grasslands and oak woodlands provided abundant seed and other plant resources for the local Indian populations. Studies of seed collecting by hunting and gathering groups in certain areas of the world indicate that this activity provides only minimal energy gains over metabolic cost (Simms 1985:124). In the North Fork basin, however, the quantities collected for consumption and the importance of grass seeds in the diet (as documented in the ethnographic and historic record) indicate that the quantities of seed collected greatly exceeded the metabolic energy expended for their collection. Furthermore, one of the most important properties of seeds is their storability. Storage of seeds in the late summer and fall for consumption in

winter when few other foods are available can be considered a form of resource banking. Resource banking was an important part of the procurement strategy of the southern Athabascans (Hamann n.d.:16). In addition, it is quite likely that certain vitamins and other nutrients found in grass seeds may have been essential for a balanced and healthy diet.

The vegetation surveys conducted for this study indicate that the grasslands and oak woodlands occupied a major portion (approximately 61 percent) of the North Fork basin. The potential food resources within these vegetation associations are significant. In addition to their use by aboriginals, the grasslands and oak woodlands provided a productive habitat for wildlife, which in turn also provided an important food resource for the local inhabitants.

Discussions with botanists during research on the subject of native grasses indicated that, in general, seeds of introduced species (for example, wild oats) are larger than those of the native bunch grasses (for example, California oat grass). Although this disparity may at first appear to support a more positive view concerning the introduction of exotic species, botanist Edith Murphy, who worked in the Yolla Bolly region in the 1920s, documented that this is not the case. One of her informants, Lucy Young (a Wailaki/Lassik born prior to the historic era) had spent much of her life in the North Fork region. She indicated that in addition to the diminishment of seed resources because of livestock grazing, elimination of native grasses containing seeds with a higher nutritive content than exotic species was one of the reasons for widespread starvation among the Indians of the region during the Conflict and Settlement Period (Hamann n.d.:16).

This difference in the nutritive value between native and introduced species is also reflected in the livestock-carrying capacity of the rangelands. During the initial phase of livestock grazing, native grasses supported a significantly greater number of livestock per acre than after the exotic species established their dominance.

The influx of settlers and the grazing and overgrazing of livestock affected not only the natural vegetation but the local Indian population as well. With the introduction of livestock after 1856-57, the plant resources of the basin were rapidly depleted. This is one of the principal factors leading to widespread starvation among the Wailaki and Lassik. In 1860, a commission was created to look into the conditions of the Round Valley Indian Reservation and of the Indians in the surrounding area of northern Mendocino County. Witnesses heard by the Special Joint Committee on the Mendocino War testified that, "The stock...[consume] the clover, grass, acorns, and wild oats, which they have hitherto subsisted on...there is hardly any food in the mountains the Indians can get" (Herbert et al. n.d.:47). While ranchers could see that the local Indian populations could not sustain themselves on their traditional diet of seeds, clovers, and acorns, they preferred to let the Indians starve rather than limit the number of livestock they grazed (Carranco and Beard 1981:55).

Appendix II outlines the kinds of plant resources available to prehistoric populations in the grasslands and oak woodlands of the North Fork basin. While some of these plant species may occur in other vegetation types (Douglas-fir forests, brushlands, etc.), for the most part such vegetation types are not nearly as productive in grass and forb resources as are the grasslands and oak woodlands.

Chapter 5
Terrestrial Fauna of the North Fork Basin

At the beginning of the historic period, Euro-Americans entering the North Coast Ranges often commented on the abundant wildlife they encountered, including extensive herds of deer and elk and the large number of grizzly and black bears (Carranco and Beard 1981:157, 167). The North Fork region also contained an abundance of wildlife that provided substantial subsistence resources for the aboriginal inhabitants. While there were numerous species of mammals, birds, reptiles, and insects inhabiting the North Fork basin, the most important of these animals for the local aborigines were deer. For this reason, the major portion of this section is concerned with evaluating the effect of land-use activities during the historic period on the deer population and formulating an estimate of the deer population prior to 1865.

Data on the other animal species and their potential availability are also presented in this portion of the study. Many animal species, including those considered uncommon or difficult to secure, provided some part of the aboriginal diet. Reasons for utilizing these resources included the desire for some variety even when staples were available, and as a supplement to the diet during those times of the year when primary subsistence resources were in short supply, or in years when these resources were difficult to secure due to natural factors. [See Appendix V for an explanation on the ranking of subsistence resources.] In many cases, however, the killing of many of the species of game outlined in Appendix III as secondary or tertiary food resources was probably opportunistic.

Deer

The deer native to the North Coast Ranges is the black-tailed deer (*Odocoileus heminous*). Formerly regarded as a distinct subspecies (*O. heminous columbianus*), it is now considered the same species as mule deer. The large numbers of deer in the North Fork region were the first natural resource to be exploited during the historic era. In 1854, brothers Pierce and Frank Asbill and mountain man Jim Neafus were the first white men to travel through the North Fork basin. They spent the winter of 1854-55 in Hettenshaw Valley (just to the north of the North Fork basin at the headwaters of the Van Duzen drainage), hunting deer in the surrounding countryside, including the upper reaches of the North Fork drainage (Keter 1990:3). At that time deer hides were a valuable commodity in the mining areas of the state. After spending the winter hunting deer and tanning their hides, Pierce Asbill transported the hides to Kingsley's trading post near the present city of Red Bluff. For the next 30 years, hide-hunting was a major economic activity in the North Fork region (Keter 1990, Asbill n. d.).

During the Ranching Period (1865-1905), southwestern Trinity County was known for its large deer population. Many of the early settlers in the area were market hunters who supplied meat to the mining areas around Weaverville and hides for making buckskin clothing and gloves. At Blocksburg, in neighboring southeastern Humboldt County, deer hides were purchased during the late 1800s for 25 cents per pound. In one 3 month period, $3,000 was paid out for deer hides (Fountain n. d.:12). A final example that illustrates the large number of deer in this region: in 1890 near Deer Lick Springs, Pleasant Grigsby and two other men killed and skinned 65 deer in one-half day (Rahm 1943:6)

The earliest homesteaders in the area depended almost entirely upon bear and venison for meat (Rahm 1943:6). In 1914, John Gray, Forest Service Ranger on the Mad River Ranger District, attempted to determine the number of deer killed by early settlers and hide hunters in the area (Table 2). He noted that, between 1880 and 1895, settlers within the Mad River Ranger District (roughly the territory outlined for the Ruth deer herd) killed approximately 45,000 deer. This is an average of 3,000 deer per year or 100 deer per settler. This figure alone exceeds the deer kill for the entire county since formal records have been kept (Burton n.d.:4). In addition, Gray (see Rahm 1943:7) lists the hide hunters as killing 82,000 deer in the years between 1854 and 1890. Thus, according to Gray's figures approximately 127,000 deer were killed in this area over a 40-year period by just those mentioned in his study. This estimate does not include a substantial population of homesteaders who inhabited the region. In 1880, 241 people were listed on the U.S. census for the Long Ridge Precinct, which included much of the North Fork basin and adjacent areas. The figure for the U.S. census in 1890 was 261.

Table 2. [After Rahm (1943:4-7)]

Major Deer Kills on Mad River Ranger District in the late 1800s

Hunters	Period	Deer
Jim Willburn and Indian Hunters (a)	1854-1895	20,000
Billy Bankhead	1855-1895	5,000
John Duncan	1860-1890	6,000
Farmer Johnson	1875-1890	4,000
Steve Flemming	1855-1890	7,000
Pierce Asbill	1854-1890	10,000
Frank Asbill	1854-1890	10,000
Ben Blockenburger and Indian Hunters	1860-1880	10,000
Joe Simmons	1865-1890	8,000
Dave Willburn	1874-1895	2,000
30 other settlers combined (b)	1880-1895	45,000
	Total	127,000

(a) Some hunters employed 15 to 20 Indian hunters using bows and arrows

(b) Estimate for 30 settlers who killed 100 deer each for 15 years

During the early historic period (1854 into the early 1900s) despite livestock populations greater than those of today and the intensive hunting that took place, there remained a relatively large population of deer within the basin. Hide hunting did cause a reduction in deer but it remained somewhat localized. In 1861 Lieutenant Lynn (U.S. War Department 1987:10) wrote in a report to his commanding officer:

> Between Spruce Grove [near Harris] and Wilburn's place on the Eel River, and especially between [the] main Eel River and Larrabee's Creek, game particularly deer, is quite plentiful, owing to the fact, I suppose, that buckskin hunter[s], killing deer in contravention of game laws and for their skins, have not yet, to any great extent, infested that region.

It seems that once the hide hunters left an area, the deer population would rebound within a relatively short time. Because the deer population remained high within the region despite the large numbers taken by hunters and homesteaders for over 40 years, one of the reasons for its present decline is probably the loss of habitat resulting from the reduction of the oak woodlands, as documented earlier. The oak woodlands are the most productive habitat in food resources for deer. As noted in Chapter 3, loss of this habitat by encroachment of Douglas-fir is widespread in this region.

In the early 1900s homesteading of the North Fork basin also contributed to a significant loss of winter range habitat because many of the homesteads were in open south- and west-facing grasslands (glades), which were important winter habitat for the deer herd.

Deer Populations in the North Fork Basin

Several studies in eastern Humboldt County have been conducted on the productivity for deer of various types of habitats in terms of soils and vegetation types (Bonn 1967, Whitaker 1965, Williams 1972). These studies present some general information on deer habitat and food preferences. In this region of the Coast Ranges, deer feed mostly on oak acorns in the fall and early winter, gradually switching to forbs and grasses as acorns and browse become depleted and forbs and grasses become more available. Use of grasslands then decreases as grasses and forbs mature and dry out in the early summer (Whitaker 1965:71). Deer continue to forage for forbs and grasses under the oaks where vegetation remains green for as much as several weeks longer (Whitaker 1965:10).

Oaks also provide cover throughout the year. One study in eastern Humboldt County indicated that deer use of grasslands decreased steadily as distance from oaks increased (Whitaker 1965:20). Another food resource that oaks provide for browse by deer is moss (*Amblystegium* spp.). This species of moss grows primarily on oak trees of the genus *Quercus*. During one study in Humboldt County, deer were observed standing on their hind legs in order to reach moss growing high in the trees. They were also observed eating moss off tree limbs that had fallen to the ground (Bonn 1967:59).

Another study in southern Humboldt County concluded that white oak acorns were preferred by deer over black oak acorns (Williams 1972:38). This study also indicated that aspect was an important factor in habitat utilization, with the south and southwest aspects having the highest use (especially during the winter) and eastern aspects the lowest. More northerly aspects may be used during the summer (Williams 1972:41). Observations showed that dense cover which was the coolest and wettest, was used primarily to escape the heat on very hot days, and deer apparently remained there only a few hours at a time. It is also significant that studies have shown that vegetation growing in the shade is lower in nutrients, notably water-soluble carbohydrates including sugar, than the same species growing in direct sunlight (Williams 1972:38)

Currently, the deer population within the North Fork basin is classified by the California Department of Fish and Game as part of the Ruth deer herd. This classification is arbitrary and is used for management purposes. The territory includes all of southwestern Trinity County south and west of the South Fork Mountain ridgeline (Burton n.d.:3). The North Fork basin occupies approximately 20 percent of this area

(a small portion of the extreme southern part of the basin is located in Mendocino County).

It is inherently difficult to estimate deer herd populations. Even today, estimates derived by different methods vary widely for the same area (Burton n.d.:6). One researcher found that population estimates for the Mendocino deer herd varied from a low of 126,528 to a high of 236,066 depending on the particular method used (Whitaker 1965:27). Deer populations within an area can also fluctuate widely because of such factors as disease, unfavorable weather affecting range conditions, predation, and hunting. In Arizona, the Kaibab (north rim of the Grand Canyon) deer herd was protected by placing a bounty on predators, removal of domestic livestock, and limitations on hunting. The deer population rose from very low numbers in the early 1900s to as high as 100,000 between 1924 and 1930. The population then rapidly declined to between 10,000 and 20,000 by 1940 (Anderson 1974:9). It is this large fluctuation apparently resulting from natural factors that makes estimating deer populations so difficult.

The estimated population for the Ruth deer herd in 1983 was 17,700. The highest estimate since record keeping began in 1960 was about 31,000 in 1964 and 1965 (Burton n.d.:9). If one recalls that the North Fork basin comprises over 20 percent of the area defined for the Ruth deer herd, then the estimated deer population for the North Fork basin would have been about 6,200 in 1964-65 and 3,500 in 1983. It should also be noted that because of its low elevation and open south- and southwest facing slopes, the North Fork basin is a major wintering area for the Ruth deer herd (personal communication, Rolando Mendez, Wildlife Biologist, USDA Forest Service). If one applies the same formula to compute the deer population for the North Fork basin as that used by the California Department of Fish and Game, then the estimated deer population in 1865 [based on Rahm's (1943) figures cited in Table 2] within the North Fork basin was about 20,000.

Given the relatively large amount of oak woodland habitat available before 1864 and the prime wintering habitat found within the North Fork basin, it is not unreasonable to estimate that, prior to the historic period, a deer population of at least 10,000 to 15,000 existed in the region. This more conservative estimate includes deer that spent at least a portion of the year within the North Fork basin.

Table 3 presents the number of deer per acre that various habitats can support. These figures are based on the productivity of habitat types for Mendocino County. What is important to note is the relative productivity and carrying capacities of each of the habitat types.

Table 3. [after Longhurst 1969 in Anderson (1974:27)]

Deer Population Supported by Habitat Type

Habitat Type	Number of Deer per Square Mile	Average Number of Deer per Square Mile
Grassland	10-30	20
Oak woodland/Grassland	60-100	80
Minor Conifer	10-30	20
Woodland/Chaparral	30-60	45
Pine/Fir/Chaparral	30-60	45
Hardwood (oak)	60-100	80

Note: No estimate for Douglas-fir was made; however, it would be as low or lower than the estimate given for minor conifers.

The productivity of oak woodlands, as presented in Table 3, is at least four times higher than that for conifer forests. This fact supports the hypothesis that the carrying capacity for deer in the basin was much greater in the past. Thus, it can be concluded that loss of oak woodlands habitat (a decline of approximately 70-80 percent) during the historic period has had a significant and negative impact on the deer population within the North Fork basin.

There is a number of natural factors that might have limited the actual size of the deer herd during the prehistoric era. These factors include disease and the carrying capacity of the seasonal ranges (summer, winter, transitional). For example, even if summer range can support a large number of animals with a habitat rich in food resources, the number of deer may still be limited by a winter habitat that is able to support only a much smaller population. This is because the deer population is limited by the carrying capacity of the least productive of its seasonal habitats. Exceeding this carrying capacity can result in starvation, in effect, naturally limiting population size.

Disease was probably not an important influence on the deer population during the prehistoric era. Prior to the historic era the herd was apparently healthy; there is no evidence of any endemic disease (blue-tongue disease, for example, appears to have been brought into the region by cattle). Appearance of disease among the deer herd did not become evident until well after the introduction of livestock [see Rahm (1943) for a discussion on this subject].

Bears

Two species of bears inhabited the North Fork basin; black bear (*Ursus americanus*) and grizzly bear (*Ursus arctos*). The larger and more fierce grizzlies were common during the early historic period, but they were probably extinct in the area by the end of the 19th century. Grizzly bears prefer an open, woodland habitat, while black bears seem to prefer a more forested environment. Thus, it is quite possible that within the basin grizzly bears were as numerous as or even more numerous than black bears during the prehistoric period when the oak woodlands and grasslands dominated.

Black bears were hunted and utilized as a food resource and although no such mention was made in the ethnographic data reviewed [including the principal ethnographers who worked in this area Frank Essene (1942) and C. H. Merriam (n. d.)], the hide was probably a much desired byproduct of the kill. One of Essene's informants (Lucy Young) indicated that during the winter, hunters from the village at Soldier Basin (CA-TRI-387) killed many black bears while they hibernated. Bear meat was smoked and used as a winter staple (Essene 1942:84).

It appears from interviews with long-time residents of the area (personal communication, Arden Stillwell, Engineering Technician, USDA Forest Service) and discussions with wildlife biologists that true hibernation does not take place in this region. Instead, during the winter, black bears tend to enter an inactive state similar to hibernation for short periods. This probably occurs during the colder, snowier portions of the winter (personal communication, Don Kudrna, Wildlife Biologist, USDA Forest Service). No information about hibernation of grizzly bears in this region was available. In view of their large mass, however, quite possibly they also had only periodic states of inactivity or did not hibernate at all.

Aboriginal groups feared and respected the grizzly bear for its strength. These animals were also dangerous competitors for deer and other resources utilized by local groups. One of Essene's (1942:4) informants indicated that black bears and grizzly were eaten. This information, however, conflicts with other Wailaki informants (Essene 1942:54) who indicated that grizzly bears were not eaten. Even if grizzlies were consumed occasionally, it is unlikely that they comprised any significant portion of the aboriginal diet.

Coyotes

Essene's (1942:4) native informants indicated that coyotes (*Canis latrans*) were not eaten by the southern Athabascans in this area and that, along with dogs, they were, as Essene (1942:54) notes, "probably [the] most strongly tabooed food." Consultants interviewed for this study believe that coyotes were not common in this region prior to the historic period and the introduction of livestock. One consultant (Interview 448) said that ranchers who first entered the area believed that coyotes followed the herds of livestock initially driven into the region from the central valley.

During the prehistoric period, grizzly bears may have occupied portions of the ecological niche now filled by coyotes thereby keeping the coyote numbers at a low level. If so, this would help to explain the increase in the numbers of coyotes in this region during the historic period when grizzly bears were hunted to extinction. Part of this increase may also be explained by the introduction of livestock (primarily sheep), which provided an additional food resource for coyotes.

As in many native cultures in North America, the coyote was a popular character in the myths of the southern Athabascans [see for example Essene (1942:93)].

Elk

Two subspecies of elk, tule elk (*Cervus elaphus nannodes*) and Roosevelt elk (*C. e. roosevelti*), historically inhabited portions of the North Coast Ranges. Historic records [see for example Asbill (n. d.) and Carranco and Beard (1981)] and interviews indicate that no elk were present in the North Fork basin when whites first entered the region in 1854. One consultant (Interview 448) indicated that the closest to the basin he had ever encountered an elk was in the Lemonade Spring area on South Fork Mountain, over 20 miles to the north. Perhaps an occasional elk strayed into the basin from areas further to the west in what is now southern Humboldt County. However, elk would have been only a minor resource in the North Fork basin, taken by hunters whenever the opportunity arose. Community ties with Wailaki groups further to the west may also have provided some opportunity for hunting this animal (Essene 1942:84).

It is possible that elk did inhabit the North Fork region in the earlier part of the Holocene and in the Pleistocene and became extinct through over-hunting, or even changing environmental or climatic factors, which occurred prior to the historic period.

Mountain Lions

Mountain lions (*Felis concolor*) were also present in the North Fork region in prehistoric times. They competed directly with humans for deer and other small game. Local residents indicated that, during the historic period, the hunting of mountain lions with dogs reduced the population to very low levels. With the recent ban on the hunting of mountain lions, their numbers appear to be on the rise (Interview 448). It is unclear whether mountain lions were hunted and consumed by aboriginal groups (Essene 1942:4). Even if consumed, they would have been an uncommon and minor part of the diet.

Other Animal Species

Many other species of animals were available for exploitation within the North Fork basin during the prehistoric period. Aboriginal groups were opportunistic and would have procured most of the species available to them for consumption or other uses. The more common animal species including smaller terrestrial mammals (rabbits, porcupines), birds (quail, ducks, grouse), and even insects (caterpillars and grasshoppers) were mostly used as subsistence resources (see Appendix III for a complete listing of these resources).

The significant changes that have taken place within the vegetation associations of the basin during the historic period are also reflected in the terrestrial wildlife populations of the region. Reduction in habitat, competition from livestock and feral pigs, hide and market hunting, trapping, subsistence hunting by homesteaders, logging, and sport hunting (which began in this area in the late 19th Century) have all contributed to decimation of wildlife.

With greatly reduced numbers of deer and other terrestrial animals and the extinction of some species such as the grizzly bear, it is difficult from today's perspective to comprehend the abundance of wildlife that enriched the daily lives of the native peoples of this region. Clearly the negative effects to wildlife over the last century including huge declines in the population of nearly every animal species within the region are the result of human activities stemming from destruction of habitat and cannot be blamed on climatic change or other factors occurring independently in the environment.

Chapter 6
Effects of Historic Land-use Activities on Streams and Aquatic Resources

In the formulation of a subsistence model for the aboriginal groups inhabiting the North Fork of the Eel River basin, perhaps the most difficult subsistence activity to document is the procurement of anadromous fish. The principal reason that these resources are so difficult to evaluate is the lack of ethnographic, historical and biological data concerning the North Fork fishery. That these resources provided a significant food supply to the local aboriginal inhabitants is certain. The question remains, however: where did fishing fit into the overall pattern of subsistence activities pursued by these people?

Although early 20th century ethnographers spent a great deal of time discussing the procurement activities related to the anadromous fishery by the Klamath River groups (Yurok, Karuk, Hupa), there are virtually no ethnographic data on fishing by the Wailaki and related inland southern Athabascan groups. Essene (1942) failed to ask his Wailaki informants any detailed questions related to the fishery in his Cultural Element Lists, and Goddard and Merriam, the other principal ethnographers who worked in the region, were primarily concerned with recording linguistic and geographical data (Keter 1993). In addition, there are no biological data relevant to the historical fishery of the North Fork.

Because of this lack of information, it was necessary to use more recent biological data and interviews with fisheries biologists and long-time residents of the area to formulate generalizations about the relative abundance and timing of seasonal runs of the anadromous fishery, the species of fish present historically in the river system, and the length of time each year these resources were potentially available. In addition, it has to be borne in mind that the North Fork of the Eel River system, like the terrestrial ecosystem of the region, has been greatly affected by the land-use activities occurring during the historic period. Therefore, it was necessary to document these historic activities and evaluate their impacts on the aquatic environment.

The North Fork of the Eel River is considered a major stream with many small-to-moderate sized tributaries (see Map 1 and Appendix IV, Table IV-B). The river is approximately 40 miles in length; its headwaters are located at the northern edge of Hettenshaw Valley. The North Fork drains an area of approximately 240 square miles. Hull's Creek, the major tributary of the North Fork, is approximately 17.7 miles in length. Its headwaters are at an elevation of 5,100 feet in the Castle Peak area. Hull's Creek drains an area of about 78.5 square miles and comprises about 30 percent of the North Fork drainage.

Riparian vegetation found along the North Fork and its tributaries includes big leaf maple (*Acer marcophylum*), red alder (*Alnus rubra*), and willow (*Salix* spp.). Other tree species including white oak, black oak, live oak, and Douglas-fir grow along the river in some locations and help to provide stream cover. Grass and forb species growing within the riparian zone are an important habitat for insects, which are a major food resource for fish.

The Biology of Anadromous and Resident Fish

The fishery resources of the North Fork can be classified as anadromous and resident. Anadromous fish spend at least part of their life in the Pacific Ocean. (Refer to Appendix IV, Table IV-B for data on the streams of the basin and the amount of potential habitat for both resident and anadromous species of fish.) A description of each of the major fish species is presented below, including a brief overview of those portions of its life cycle relevant to this study.

Anadromous Species

Coho (Silver Salmon)

Oncorhynchus kisutch

Coho salmon range in weight from about 5 to 12 pounds at maturity. It is not unusual, however, for some of the larger fish to weigh up to 15 pounds or more. There are two types of coho: short-run coho, which move up the smaller coastal streams, and long-run coho, which migrate considerable distances. Coho prefer cold streams with deep summer pools and plenty of cover for immature fish (Moyle and Morford 1991:9).

Salmon and steelhead trout have a number of common requirements and shared characteristics. These include a habitat of cool or cold water and the need to spawn in freshwater. The spawning habits of the coho and chinook are similar, although coho prefer somewhat smaller streams; their young also seem to prefer the smaller tributaries. Coho enter most of the streams along the north coast of California in the fall and winter shortly before spawning. Migration depends on when the fall rains begin and when the water level of the streams begins to rise. Spawning occurs immediately when the fish reaches its native stream. Spawning must take place in cold clear streams with a gravel bottom. Fish prefer spawning in the lower end of a pool where water begins to pick up speed or in other, similar locations with moving water. The female digs a nest and creates a pit into which she deposits some eggs. The male immediately fertilizes the eggs and the nest is then covered by the female. This process is repeated several times until all the eggs are laid. Both fish then die within a short period after spawning, although some may survive as long as a week or two.

Eggs hatch in about 2 months; over the next few weeks, the young wriggle through the gravel to the stream. They remain in the general vicinity of their birth until they are ready to travel to the sea. Juvenile coho are voracious feeders; a major portion of their diet consists of aquatic insect larvae, terrestrial insects, and small fish when they are available (Moyle 1976:118).

Coho usually migrate to the ocean when they are about 5 to 6 inches long and just over 1 year old. Thus, they spend at least one summer in the river system (rarely, some individuals spend 2 summers) before heading to sea. Salmon can only summer in waters that stay below 70 degrees or they are unable to survive. They normally remain at sea 2 to 3 years before migrating upstream to their place of birth for spawning. On the main Eel, the run of coho takes place in January and early February (Steiner n.d.:10). Although no evidence indicating the presence of coho in the North Fork River system could be documented for this study, their presence prior to the historic period cannot be entirely ruled out at this time.

Chinook (King Salmon)

Oncorhynchus tshawytscha

Chinook salmon are larger than the coho, averaging about 20 pounds and occasionally exceeding 50 pounds. The record fish for California is 85 pounds. Before 1963, the salmon catch in California was over 90 percent chinook (Fry 1976:78). The life cycle of the chinook is similar to that of the coho. The principal difference is that chinook usually prefer the larger creeks and rivers. Juveniles migrate to the sea at about 4 months, when they are about 4 inches long. They remain at sea about 3 years before migrating upstream to their place of birth.

Fry (1976:78) notes that, in most stream systems of the North Coast Ranges, chinook begin their migration runs in the fall, with the exact time varying from river to river. It is important to note that some races of chinook do enter some river systems (including the Eel river system) in the spring.

Spring chinook were at one time the most abundant salmon in California. Prior to the historic era, as many as 500,000 to 600,000 fish may have spawned each year in the Sacramento/San Joaquin River system alone. Today, there are small runs of less than 1,000 fish in the Klamath (spawning takes place in the Salmon River drainage) and Sacramento (spawning takes place on Mill and Deer Creeks) basins.

Some chinook that run in the spring are also produced by hatcheries on the Trinity and Sacramento Rivers. These fish have been hybridized with fall-run salmon, which are genetically unsuitable as replacements for the true native spring-run salmon (Moyle and Morford 1991:8).

Steelhead Rainbow Trout

Oncorhynchus mykiss

Compared to the salmon, the steelhead is relatively long lived. Individuals may live to be 6 or 7 years old and some females may spawn more than one time, returning each year to the ocean. Most mature steelhead weigh less than 10 pounds, but some may weigh more than 20 pounds.

The life cycle of the steelhead is similar to that of the salmon. It prefers cold fast-moving streams. It usually spawns, depending on the stream system, from February to May. Like salmon, steelhead have well-developed homing abilities and usually spawn in the same stream where they were born. This instinct often leads to local races of trout adapted to the local conditions of a particular stream (Moyle 1976:13). Spawning is similar to that described for the salmon, and the urge to migrate to the ocean seems to be related to size. Steelhead usually travel to sea after spending about 2 years in the vicinity of their birth; they usually spend 2 to 3 years at sea before returning to spawn the first time.

Although steelhead are predominately anadromous, some individuals (a very small part of the population) mature without ever migrating to the sea. There are no sub-species, but they are classified as summer-run, fall-run, winter-run, or spring-run steelhead depending on the time of year when they enter a stream on their spawning run. Runs which begin in the fall or winter, are likely to last until March or April. Smaller fish, called "half-pounders", usually weighing ½ to 1½ pounds are also known to return to their native streams after less than 1 year at sea.

Spring-run steelhead enter the river systems about March or April [Fry (1976:60) notes their presence in the Eel River system]. These fish migrate upstream towards the headwaters of the larger and cooler streams and spend the summer in large deep holes in the river and suitable tributaries. They do not spawn until the next spring.

Today, a small population of spring-run steelhead (also referred to locally as summer steelhead) remains on the Middle Fork of the Eel River. For example, some of these fish have been observed in large pools in Balm of Gilead Creek, a tributary of the Middle Eel (personal observation). These fish are nearly extinct in the Eel River system because of

degradation of habitat and poaching. As Moyle and Morford (1991:11) note:

> The fact the fish are confined today to the most inaccessible canyons is presumably an artifact of poaching. Even in these areas, human activities may be gradually eliminating one of the most spectacular sights in California—a deep, clear pool in a sun baked canyon, full of immense fish cruising slowly back and forth, waiting patiently for the fall.

Pacific Lamprey

Entosphenus tridentatus

Lampreys are not true fishes, but rather, a primitive class of fish-like creatures called cyclostomes. Although they are eel-like in shape they are not related to eels, which are true fishes. Lampreys are anadromous. The young are blind, have no teeth, and no sucking disk. They live in streams, feeding on vegetable matter and leading what can be best termed a worm-like existence.

After several years, they metamorphose into the adult form. At this time they travel to the sea, where they feed on a variety of fish. Lampreys (which in this study are sometimes referred to by their common North Coast name of eels) can reach a length of 30 inches and weigh about 1 to 2 pounds at maturity. They are considered an excellent food source when taken at or near the river mouths, but they deteriorate rapidly as spawning time approaches.

At sexual maturity they return to fresh water; however, they apparently do not always return to the same stream. They are adept at surmounting natural (or human-made) barriers in streams. One consultant (Interview 445) has witnessed this phenomenon. Using their sucking disk to hold on to a rock, they contract their bodies, then quickly snap forward, release their hold, and reattach themselves to another rock. By doing this repeatedly, they are able to climb formidable barriers.

Like salmon, lampreys spawn when the water is flowing over a gravel bottom; prime habitat can be considered the same for both species. The female forms a shallow depression and extrudes her eggs. A waiting male then fertilizes them. After spawning, the adults die.

It appears that the historic eel run took place on the North Fork in the late spring (about May). One consultant (Interview 445) noted that he was told that Indians in this area did eat eels caught in the North Fork. He also noted that the eels seemed to know when the last heavy rainfall of the season was over, and that was when their run would begin. This timing was critical to ensure that the river would not rise and wipe out the beds after the eels had laid their eggs.

Resident Species

Rainbow Trout

Oncorhynchus mykiss

Resident trout are the same species as steelhead. They do not, however, have the anadromous gene. Steelhead spawn about 2 to 3 months earlier than resident trout and therefore have some advantage over them. Thus, if there is a healthy steelhead population, there is usually a correspondingly smaller resident trout population.

Resident trout usually occupy smaller streams, including the upper reaches above the natural barriers, that halt migration of anadromous fish. Ideal habitat, like that of steelhead, is cold, swift, and well-oxygenated water with rocky riffles (Moyle 1976:35).

Today, adults average about 6 inches long. One consultant (Interview 445) remembers during his youth catching trout on the North Fork as long as 12 to 13 inches and averaging about 6 to 10 inches. He said that the best time to catch trout was the summer.

Sucker

Catostomus humboldtianus

The Eel and Mad Rivers contain a sub-species of sucker related to those found in the Central Valley. It is believed that they first entered the North Coast river systems through the capture of a headwater stream that originally flowed into the Sacramento River (Moyle 1976:17).

This fish is found in the North Fork drainage and may reach a length of 2 feet and a weight of 4 to 5 pounds. They do not compete seriously with other fish except occasionally with trout for food. The young are consumed as food by predator fish; mature suckers act as bottom scavengers. Because a healthy population of resident and anadromous fish inhabited the North Fork, suckers probably were not a significant food resource for the Wailaki and Lassik, although some suckers were undoubtedly taken in the summer when stream flows were low.

Western Roach

Hesperoleucus spp.

Although today, roach may play a part in the ecology of the stream environments, they probably are not native to the area (Moyle 1976:76). Because of their small size (2 to 3 inches), even if they were present in the stream system prior to the historic period, they would not have been a significant food resource.

Historic Land-use Activities and their Effects on the Aquatic Environment

Land-use practices during the historic period have not only affected the terrestrial environment of the North Fork basin, they have also greatly affected the rivers and creeks comprising the aquatic environment. For this reason, the North Fork of the Eel River and its tributaries are very different streams today than they were when the Wailaki and Lassik depended upon them for a large portion of their subsistence resource base.

The following discussion outlines the impacts that have occurred on the stream systems of the basin during the historic period and their effects on anadromous and resident fish.

Ranching Period: 1865-1905

Large numbers of sheep and cattle grazed on rangelands within the North Fork basin during this era (Burcham 1981 and Keter 1994). Livestock populations during this period were much higher than those of today. For example, at one time Fenton's Ranch on the lower part of the North Fork had 30,000 sheep. The grazing (and in most cases overgrazing) of rangelands adversely affected the aquatic resources and water courses of the basin (Photograph 9). Furthermore, livestock tends to congregate within the riparian zones more often than in the surrounding uplands (Armour et al. 1991:7).

In addition to the effects from livestock, a large population of feral pigs became established in the region during the 1860s. The pigs continued to inhabit the basin well into the 20th century, but today they appear to have been eliminated (Interview 449). Negative effects to the stream systems of the basin by feral pigs and livestock included:

- Disturbance of the riparian vegetation along stream courses
- Erosion from these hoofed animals making trails and otherwise disturbing the highly erodible Franciscan Formation soils on steep mountainous slopes
- Collapse of overhanging banks and other stream course disturbance from trampling
- Increased pollution from animal waste

Photograph 9: *North Fork of the Eel River. Overgrazing combined with flooding has greatly reduced riparian vegetation along the course of much of the river. Livestock tend to congregate along waterways in the summer leading to increased erosion further undermining stream terraces.*

- Increased erosion from damage to plant cover by overgrazing

- Rooting and other soil disturbance.

Another factor that must be considered is the commercial fishing that took place at this time on the lower Eel River. This activity began in 1851; canned and salted salmon from this region were considered some of the best-tasting in the world. They were shipped to markets as far away as New York and Australia (Lufkin 1991:8-9, Wainwright 1965:8).

The major activity related to commercial fishing apparently took place during the fall runs. It usually ceased by late November as seasonal water flows became substantial. Despite commercial fishing greatly reducing the fall runs on the Eel river, the effects to the winter and spring runs may not have been significant on the North Fork. [Refer to Wainwright (1965), who presents a compendium of articles on this subject for the years 1854 to 1892 from the *Humboldt Times*, the major county newspaper of that period.] However, there is a lack of biological data on this point because a fall run of salmon at the mouth of the Eel could be a winter run of fish in the North Fork. For example, on the Trinity River, salmon enter the river system in August but spawn in the upper river 2 to 3 months later in October and November. It is possible, therefore, that salmon may have entered the lower Eel River several months prior to their appearance in the North Fork River system.

Homesteading Period: 1905-1940

Subsequent to the establishment of the Trinity Reserve (now the Six Rivers National Forest) in 1905 and the passage of the National Forest Homestead Act and the Indian Allotment Act, there was an influx of homesteaders into southern Trinity County, including the North Fork basin. Homesteads usually consisted of a 160-acre parcel of land with some limited improvements including a house (or more often a primitive cabin), barn, fencing, and some domestic livestock, which also grazed on adjacent National Forest lands. Homesteaders, by law, were prohibited from claiming areas of the National Forest with commercial stands of timber. The preferred locations for settlement were the oak woodlands and savannas adjacent to small springs on the more open southern slopes.

One consultant (Interview 444) spent time fishing along the North Fork during the summertime in the late 1930s. He remembers seeing remains of posts and chicken wire that had been strung across the river by homesteaders as weirs to catch salmon. He also indicated that it was not uncommon to see the remains of salmon carcasses along the river banks. One long-time resident of the North Fork region (Miller n. d.) wrote that during the early 1900s, "Indians dammed the North Fork of the Eel River and caught salmon by night-flares from the river bank. There were no game laws at that time." One consultant (Interview 445) noted that, like the Indians, homesteaders also caught fish at night by using flares and that it seemed the runs were better at that time.

The influx of settlers, and the associated land-use activities including the tilling of the soil and the concentration of livestock in relatively small areas, all adversely affected the streams and the hydrologic cycle of the basin.

The Modern Era

After World War II, small scale logging and related ground disturbing activities including road building began to take place on private lands within the basin (for example, on the Travis Ranch and some former homesteads owned at that time by the Twin Harbors Lumber Company). Most harvestable timber within the basin is, however, on public lands, where timber harvesting and associated road building did not occur to any significant degree until the early 1970s on National Forest lands. (This is not the case for other portions of the Eel River basin where logging began much earlier).

Interview data (Interviews 445,448) indicate that, despite the impacts from historic land-use practices, the fishery of the North Fork was still relatively productive until the 1964 flood. An earlier flood in 1955, although considered a significant event, apparently did not affect the fishery greatly.

In 1964, a catastrophic event, the "Christmas Week Flood", resulted in severe damage to the North Fork of the Eel River and its tributaries. Heavy snows followed by warm and heavy rainfall caused flooding throughout the North Coast Ranges. In the North Fork region, the flooding severely affected the stream channels of the basin. The damage to fish habitat was severe and almost totally destroyed anadromous fish populations. A study for the California Department of Water Resources (Brown and Ritter 1971:25) noted that erosion from the storm "was most severe in the eastern section of the Eel River basin where the North and Middle Forks of the Eel River were fed by runoff from the steep westward facing slopes."

While earlier impacts on the stream system from land-use practices probably contributed to the severity of flooding, one consultant interviewed by a fisheries biologist (Steiner n.d.:14) indicated that, although logging may have contributed to the flooding in 1955 and 1964, he also saw unlogged areas come down in those years. This appears to be the case for the North Fork basin, where only limited logging had occurred prior to this time (Interview 445).

After the flood, silt and sedimentation totally filled the stream channel. One consultant (Interview 448) indicated that the channel was so completely filled with soil and debris that the riverbed was level and vehicles could drive up it for miles. Major water holes in the channel (there was a large, deep hole on the North Fork near the mouth of Soldier Creek, for example) were filled in, and a thick sediment covered the gravels on the river bottom. Subsequent research on flood damage indicated the 1964 flood deposited one-seventh of the total sediments deposited over the last 1,500 years as measured in the estuarine deposits of the Eel River (Steiner n.d.:1). The flood also washed out or buried riparian vegetation and washed out gravels or buried them with sand and silt (Steiner n.d.:8).

The result of this catastrophic flood was that the already declining fishery was nearly decimated. One consultant noted that "1963 was the last good year [for fish] and streams were closed in 1965-66. This made no difference in the fisheries, or rather, the fisheries continued to decline" (Steiner n.d.:9). Other factors possibly affecting the salmon population during recent times must also be mentioned: the increased mechanization of the ocean-going fishing fleet since World War II and sport fishing. Since the 1964 flood, these two activities may have made the recovery of salmon populations more difficult.

The adverse and cumulative impacts outlined in this section have resulted in significant reductions in both anadromous and resident fish populations through:

- Loss of habitat for reproduction
- Reduction of the terrestrial food supply affecting the aquatic food chain
- Reduction of aquatic resources (insects) low on the food chain
- Loss of summer habitat because of increased water temperature and decreased flow rates
- Loss of summer habitat by aggradation of deep holes
- Lowering of water quality
- Nutrient-rich runoff (animal waste) causing oxygen depletion in slow-moving water and encouraging algae growth
- Sport and especially commercial ocean fishing reducing the breeding population.

The cumulative effects from historic land-use practices in combination with the flood and modern land-use practices (principally grazing and logging) have dramatically altered the aquatic habitat of the North Fork and its tributaries over the last 120

years. Today, the stream system contains very few anadromous fish. With the recent increase in logging and road building on private and public lands within the basin, stream degradation will probably continue, or at the very least, modern land-use activities will hinder the recovery of stream channels and the improvement of fish habitat that are essential if anadromous fish are to again inhabit the North Fork of the Eel in any great numbers.

The Hydrologic Cycle

Historic land-use practices have also influenced fish habitat by affecting the hydrologic cycle of the basin. Long-time residents of the area interviewed for this study agreed that 40 to 60 years ago the streams within the basin used to run at higher water levels in the summer than they do today. They also noted that many of the springs in the region have dried up or have greatly reduced flows during the summer dry season, even allowing for the recent drought. Many of the homesteads recorded within the basin do not have evidence of an active perennial spring or other water source on or adjacent to the claim. [See, for example, recorded sites CA-TRI-1202/H, CA-TRI-991/H, and 05-10-54-266, Heritage Resources files, Six Rivers National Forest, Eureka.] However, long-time residents indicate that all of the homesteads in this area formerly had at least a small spring. As one consultant (Interview 448) noted, "A homestead had to have a spring on it or you couldn't live there."

Historic land-use activities related to ranching and homesteading probably produced some minor changes in groundwater flow to springs and to summer flow rates in the streams of the basin. These impacts to the hydrologic cycle included increased runoff as a result of soil compaction, loss of ground cover, and reduction of riparian vegetation.

The most significant factor affecting the hydrologic cycle and groundwater within the basin, however, was the change in the distribution of vegetation communities documented earlier in this study. The increase in the extent of Douglas-fir forests, the corresponding loss of the oak-woodland vegetation type, and the increase in the density of brush and understory species throughout much of the region have resulted in an increased loss of groundwater through interception and evapotranspiration (for a discussion of this subject, see Lull 1964:6.17-6.23).

Lull (1964:6.17) noted that:

> ...the vigorous absorption of soil moisture by roots, together with losses due to interception [the reduction of precipitation reaching the ground because of leaf canopy], usually more than offset the effects of vegetation in retarding evaporation from the soil. Thus the soil in forest openings tends to have more moisture than soil beneath trees.

Studies of the effects of forests on stream flow volume indicate that, in areas where forests were harvested, the more intensive the cut, the greater the increase in water flow, and the less evapotranspiration (Lull 1964:6.24-6.25, Troendle 1989:108). In some areas, this factor alone can result in a difference in the reduction of groundwater by 15 to 20 percent (Troendle 1989:114).

In one study conducted by the Forest Service on a small watershed in western North Carolina, 33 acres were cut and during the following year seasonal streamflows increased by 60 percent (Lull 1964:6.24). Although no definitive research has been conducted on hardwood forests, the consensus at this time is that hardwoods use less water than conifers.

Today, summer velocity of the North Fork is slow to non-existent (in the winter there are substantial flows). Fisheries biologists (Reneau and Barnes 1982) who surveyed the North Fork of the Eel River in 1982 concluded that:

> ...summer and fall are very inhospitable to those fish which did not move downstream as the late spring flows diminished. Because of the low flows and intermittent nature of the North Fork of the Eel River during summer and fall, along with very high [water] temperatures only those salmonids holding in deep pools have a chance for survival.

Although the hydrologic cycle is a complex subject with many variables, including the ability of some soils to hold moisture better than others and the composition of the underlying geology, a significant

increase in the extent of the Douglas-fir forest has clearly been a major factor in the reduction of summer flow rates in streams and springs. [An example of this phenomenon could be seen following the 1987 Travis Fire that occurred in the eastern portion of the basin. Hydrologists noted a significant increase in ground water flows during the summer of 1988 (personal communication, Kenneth Wright, Hydrologist, USDA Forest Service)]. This reduction during the historic period has important implications for interpreting the prehistoric record. Predictive models related to site location or function and those based on the procurement and distribution of potential subsistence resources must take into account the recent changes to the hydrological cycle of the basin.

The Availability of Anadromous Fish in the North Fork of the Eel River System: an Historical Model

Biological, historical, and ethnographic data on the subject of anadromous fish within the North Fork of the Eel River system are lacking. Indeed, the fisheries biologists interviewed for this study disagreed over such basic data as the timing of the seasonal runs. Some of those interviewed even questioned the likelihood of salmon ever having inhabited the upper portions of the North Fork drainage.

For these reasons, the anadromous fishery of the North Fork basin has proved to be problematic to evaluate. The timing of seasonal runs and the numbers of salmon and steelhead for procurement as a food resource are critical to any regional prehistoric subsistence model. The following discussion synthesizes interviews with both fisheries biologists who have worked in this region and long-time local residents, as well as ethnographic data, to produce a model of the anadromous fishery for the North Fork River basin as it existed prior to the historic era.

Because definitive biological data were lacking, the model of the anadromous fishery was developed by integrating the most reliable and consistent data from the regional ethnographic record with information provided by interviews with long-time residents who had direct knowledge of the timing of runs and the species of fish in the river system as far back as the mid-1930s. The biological characteristics of the various species and races of fish that inhabit the Eel River today were then correlated with the interview data to formulate an historic model of the anadromous fishery for the North Fork of the Eel River drainage.

Today, there is a barrier of slide debris and a large rock called Split Rock about 5 miles above the mouth of the North Fork between Asbill and Wilson Creeks. This barrier may have been active historically but it appears to have worsened as a result of the 1964 flood and has contributed significantly to the lack of anadromous fish in the upper portions of the North Fork since 1964. Below this barrier for some distance there is a series of small waterfalls 5 to 7 feet high (Interview 446). These falls would have been at least a seasonal barrier to fish during the historic era. One consultant (Interview 445) indicated that, when he was a young man living on the North Fork near Hull's Creek, the runs of salmon and steelhead coincided with periods of precipitation when the river and creeks were high. Between storms very few fish came up the river, and homesteaders did not even bother to fish in the winter except when the waters were high. Perhaps the higher waters somewhat mitigated the effect of the waterfalls and the slide at Split Rock as natural barriers to upstream migration of anadromous fish. This would be especially true for chinook, which are not as aggressive or agile in surmounting barriers as steelhead.

One reason fish run late in the Eel River system (especially in the North Fork) is the erratic nature of fall rains and the number of roughs on the river that are barriers at low water flows. Thus, over time,

genetic variation, which differs slightly from stream to stream, may have favored those fish that migrated during periods when such barriers were not substantial impediments. Furthermore, in view of the propensity of anadromous fish species to inherit traits related to seasonal migration, the timing of runs of such fish on the North Fork during the historic period is probably analogous to that of the prehistoric period.

Historic Salmon Runs in the North Fork

Ethnographic data on the procurement of salmon in the North Fork are nonexistent. Foster (1944:163) notes that, on the Middle Fork of the Eel River, "Black salmon in the fall were followed by winter and spring salmon in those seasons." The black salmon referred to are a race of fall- or winter-run chinook (Interview 446). Essene (1942:84) notes that, "Late February or March marks the beginning of the silverside salmon run." The silverside salmon referred to are spring chinook. Essene does not make clear if the run he refers to was on the Middle Fork or the North Fork. Several of his informants had lived in the North Fork drainage but were living in Round Valley when they were interviewed.

One consultant (Interview 445) remembers homesteaders in the 1940s netting salmon on the North Fork. He indicated that steelhead were usually taken with a hook and line. The North Fork had no fall run of salmon but there was a small run in January and another in late March or early April, with both runs lasting about two to three weeks (Interviews 445, 448). Another consultant (Interview 446) noted that he had observed spring runs of chinook salmon in the North Fork prior to the 1964 flood.

It is possible that salmon runs on the North Fork were limited by the natural barriers noted earlier. Not all of the fisheries biologists interviewed were in agreement on the presence of chinook above Split Rock prior to the 1964 flood. Some indicated that chinook may not have been able to surmount the natural barriers along the lower portions of the river since they are not as aggressive or acrobatic as the steelhead in breaching natural barriers. All did agree, however, that the North Fork contained suitable salmon habitat.

No evidence was found for the presence of coho in the North Fork. It is possible, however, that at one time coho did inhabit the river system. They have a greater need than chinook for cooler water, spending one summer in the stream before migrating to the ocean, and are usually found in habitats with a canopy of riparian vegetation and undercut banks. Heavy grazing, the destruction of riparian vegetation, and the trampling of stream side banks during the late 1800s may have resulted in destruction of habitat and extinction of this species within the North Fork basin prior to the 20th century. A run of coho still occurs on the South Fork of the Eel. This population is estimated to be under 1,000. It is estimated that, at one time, the South Fork carried 40,000 coho (Moyle and Morford 1991:9).

From the data presented above, I hypothesize that, during the historic period, there were two seasonal runs of chinook salmon on the North Fork. The first was a winter run (it might even be classified as a late-fall run) that took place in mid-January to early February and lasted about three weeks. Biological data confirm the potential for a late-winter run of salmon in the North Fork. Chinook have a wide range of migration patterns, and a winter run could occur as late as February. These fish would be dark, corresponding to the "black salmon" referred to by Essene.

The second run of salmon in this hypothesis took place about late March or early April and would be considered a spring run. These fish (the "silversides" described in the ethnographic literature) are a separate race of chinook that are fat and silvery during their run. They spend the summer in deep holes before spawning the next fall.

The salmon population for the winter and spring runs on the North Fork simply cannot be estimated on the basis of local biological or historical data. In one study (Humboldt County Department of

Natural Resources and Public Works 1977), which uses a generalized model formulated to estimate anadromous fish populations on the basis of available habitat, the authors estimate that one mile of suitable habitat on the Middle Fork of the Eel River (above Dos Rios) will support about 200 chinook and 150 steelhead. This estimate is based on current habitat, which, as noted earlier, has been greatly reduced by historic land-use activities and changes to the hydrologic cycle.

Prior to the historic era, there were apparently at least 46.2 miles of anadromous fish habitat within the North Fork basin. This figure is based on estimates from surveys of fish habitat on the North Fork River system as presented in Appendix IV, Table IV-B. By using the method cited above to estimate fish populations based on available habitat (although the North Fork is smaller than the Middle Fork, this fact is compensated for by the more productive habitat existing during the prehistoric era), one can project that the total number of salmon entering the North Fork on a yearly basis was at least 9,240. These fish would have been available as a procurement resource in the form of spawning runs, periodically from about mid-January until Mid-April. Some spring salmon and land-locked winter salmon would also be available through the summer and into the early fall until the rainy season.

While this population estimate is large, it is dwarfed by the numbers of fish caught in the Eel River during the 1800s. For example, an article in the *Humboldt Times* (December 19, 1857) noted that, from October 18th until November 5th, 1857, 16,000 salmon filling 800 barrels at 200 pounds each were caught on the lower Eel River (Wainwright 1965:6).

Historic Steelhead Runs in the North Fork

On the basis of interviews and biological data, I hypothesize that there were two separate runs of steelhead on the North Fork. A winter run (or late-fall run) probably took place in mid-to-late January with the heaviest part of it lasting about 2 to 3 weeks. Winter-run fish probably continued sporadically for several more weeks beyond this time. These fish would spawn in late May and early June. According to fisheries biologists, the North Fork of the Eel River was quite likely the location of the latest yearly spawning activity by steelhead in California and possibly in North America. Occasionally, some of these winter-run fish probably become trapped in the deep pools by low water flows and spent the summer in the river before migrating to the sea.

The second run was a spring run and probably took place about mid-March and lasted for three to four weeks or possibly longer. This was probably the dominant run of steelhead in the North Fork, a conclusion drawn from discussions with local consultants who indicated that the January run was smaller and that the main run took place in the early spring. Consultants indicated that the spring run lasted about four weeks. One interviewee (Interview 445) indicated that according to local lore, "the spring run ends when the burclover [*Medicago arabica* an introduced species] blooms."

Spring-run steelhead are a separate race that spends the summer in deep pools and spawns the next fall or winter before returning to the ocean. There were also spring runs of steelhead on the Middle Fork of the Eel and Mad Rivers, where fish spent the summer in deep holes on the upper portions of these stream systems. This fact has implications for the ethnographic groups of the region, who were linked by cultural and kinship ties to these areas (Keter 1993).

As with salmon, it is difficult to estimate the number of fish in each run during the historic era. One interviewee speculated that a large run on the main Eel River could have been in excess of 10,000 fish. If one considers the habitat potential for steelhead (Appendix IV, Table IV-B) and applies the formula referred to in estimating salmon populations (that is, 150 steelhead per habitat mile), the population of steelhead in the North Fork drainage prior to 1860 would have been about 6,930.

This figure does not include potential habitat above the falls on Hull's Creek below Hull's Valley (Interview 445). This falls is a formidable barrier, estimated to be least 10 feet high. As noted earlier, steelhead are better able to surmount natural barriers than chinook. Thus, if steelhead surmounted this falls, an additional 15 miles of habitat on Hull's Creek and its tributaries (a conservative estimate) would have produced an additional 2,250 fish. [One consultant (Interviewee 445) confirms the presence of steelhead in Hull's Valley before the 1964 flood.] Combining this figure with that for the rest of the stream system would put the steelhead population for the North Fork basin at about 9,180. These fish would have been available in significant numbers from mid-January to as late as early June. In addition, a significant number of steelhead would have been available in deep pools as a potential summer subsistence resource.

The population estimates presented for both salmon and steelhead should be viewed as the potential number of fish migrating upstream in an average year. The total number available for humans would have varied, perhaps greatly, from year to year, depending on stream conditions.

These population estimates for both salmon and steelhead were primarily developed to be a point of departure for future research and discussions related to the formulation of a prehistoric subsistence model.

Conclusions

The data presented indicate that anadromous fish populations have declined to the point of extinction since the beginning of the historic period, with the greatest decline since 1964. The principal reasons for this precipitous decline are reduction of habitat resulting from historic land-use practices and the catastrophic flood of 1964. As Moyle and Morford (1991:7) note, fish "are the most important components of the ecosystems that support them and their decline reflects the deterioration of the ecosystems."

Further evidence in support of the hypothesis that the decline of fish populations and their failure to rebound after the 1964 flood are due to destruction of habitat is found in the corresponding reduction in the eel population during this same period. Eels have not been considered a desirable food resource during the historic era, yet their numbers have declined. Because their spawning habitat is the same as that of salmon and steelhead, loss of such habitat coupled with warm water temperatures during the summer and low flow rates are major contributing factors in the general decline of the anadromous fishery of the North Fork.

Today, steelhead, which are more adapt at surmounting barriers than chinook, are still occasionally found in the North Fork. Coho, on the other hand, are extinct or possibly never entered the North Fork River system. In 1986, during an archaeological survey in the spring, a chinook salmon mandible was identified by the author along the North Fork just to the north of its confluence with Rock Creek. Against all odds, an occasional chinook may travel up the North Fork (personal observation; personal communication, Jerry Boberg, Fisheries Biologist, USDA Forest Service). Such journeys are, however, an uncommon event and, for all practical purposes, chinook are extinct on the North Fork above Split Rock. Until this rock barrier is removed and natural or human-assisted restoration of spawning habitat occurs, runs of salmon and steelhead on the North Fork will be a thing of the past.

Chapter 7
Paleoclimatic Factors Influencing Vegetation Dynamics in the North Fork Basin

The purpose for this review of Holocene climatic and pollen data for the North Coast Ranges is to formulate a model of the environment for the North Fork basin over the last 5,000 to 8,000 years. Environment, like culture, is not static. In view of the documented changes in climate for this region during the Holocene, the environment was clearly different during the mid-Holocene than it was during the ethnographic period.

By integrating the 1865 baseline data on vegetation with regional climatic and pollen data, I formulated a time-sensitive or diachronic model of the environment for the prehistoric period. It can be used to predict the kinds and amounts of terrestrial and aquatic subsistence resources available to prehistoric populations. Ultimately, this model could contribute to a better understanding of the past in the North Fork region by providing a context for interpretation of the archaeological record.

Pollen Analysis in the North Coast Ranges

The following discussion of past vegetation communities within the North Fork region is based primarily on a review and analysis of pollen studies by James West from locations on Pilot Ridge (West 1983a), Six Rivers National Forest, and at Lily Pond (West 1983b) and A-M Lake (West 1991), both of the latter located on the Mendocino National Forest. These studies are relevant because of their radiocarbon dates and time-depth, as well as the proximity of these sites to the North Fork basin. The North Fork basin is located about mid-way between the Pilot Ridge and Lily Pond sites and less than 10 miles to the west of the A-M Lake site. The summary of data on pollen samples presented below is limited to a brief discussion of the findings relevant to this study (see also West 1993).

Pilot Ridge Pollen Data

The pollen cores were taken from a small marsh adjacent to CA-HUM-556, a prehistoric site located at an altitude of approximately 4,200 feet. Two radio-carbon samples were recovered (West 1983a:3.19): Sample IA taken at a depth of 20-22 cm and dated 2,640 B.P. (± 70), and sample IIA taken at a depth of 128-133 cm dated 4,600 B.P. (± 100). The results of the pollen samples are outlined below.

Pollen Zone III (26.2-139 cm)

This sample dates from approximately 5,000 B.P. to around 2,600 B.P. It includes high counts for oak, with Douglas-fir counts increasing over time. Also noteworthy is the almost total lack of

tanoak and chinquapin (*Castanopsis chrysopylla*) pollen until about 2,600 B.P.

Pollen Zone IV (0-26.2 cm)

This sample, which dates from about 2,600 B.P. to the present, is characterized as having high counts for Douglas-fir, pine, tanoak, and chinquapin. Douglas-fir appears to have increased in numbers since the era of Zone III, while oaks have decreased.

West (1983a:3.21) concludes that the currently composed Mixed Evergreen Forest on this portion of Pilot Ridge did not form until approximately 2,700 to 2,800 years ago. Prior to that time there were greater numbers of pine and oak, with fewer Douglas-fir. These changes in the pollen record reflect changes through time in both species composition and distribution of trees on Pilot Ridge; they are consistent with other studies of the environment in the North Coast Ranges (Adam and West 1983).

Lily Pond Pollen Data

The most complete pollen core referred to in this study was that taken from Lily Pond, which is about 4 kilometers southwest of Fouts Springs in Colusa County. This area is better characterized as a marsh than as a pond; it is located at an altitude of approximately 4,000 feet above sea level. Several samples were radio-carbon dated, with the oldest registering 8,700 B.P. (± 100). The lowest portion of the core, as determined from radio-carbon dating and sedimentation rates, was estimated to be about 9,700 B.P. (West 1983b:4).

Pollen samples from pond vegetation indicate that around 7,000 B.P. the water level was lower than during the previous period (which extended to 9,700 B.P.). During the more recent past, the water level of the pond has again increased (West 1983b:10).

The pollen core data for Lily Pond (see figures 4 and 5 in West 1983b:8-11) are summarized in the next column:

Pollen Zone I (685-705 cm)

The sample indicates that, during the period prior to 8,700 B.P., this area was an open pine forest with a sparse shrub and herbaceous understory. Oak were present, but not a major part of the vegetation associations. There are high counts for TCT (*Taxaceae, Cupressaceae,* and *Taxodiaceae*) pollen, consistent with pre-Holocene sediment studies at Clear Lake. Douglas-fir pollen is present, but it is a very minor component.

Pollen Zone II a and b (596-685 cm)

This zone appears to be a transitional period during which the number of oaks increased. Lily Pond was shallower and supported dense growths of pond weeds. The Douglas-fir pollen count is reduced and becomes almost non-existent in the sample.

Pollen Zone III (300-596 cm)

During this period—between radio-carbon dates 7,490 B.P. (± 70) and 3,370 B.P. (± 100)—oaks became a major element of the vegetation in the area. Pine counts remain high and Douglas-fir is almost non-existent in the sample. Significantly, true fir (*Abies*), which were present in low amounts in the earlier levels, disappear completely from this sample.

Pollen Zone IV a and b (0-300 cm)

Major changes in vegetation took place during this period (after 3,370 B.P.). True fir reappear, and at about the same time Douglas-fir counts begin to increase steadily until this species becomes a major component of the forest. Oak counts drop slightly, while pine counts increase slightly within sub-zone IVa.

West's (1983b:12-14) interpretation of these data is that the most important factor affecting the changing pollen counts is climate. He infers that cooler conditions prevailed during pollen Zone I, which marks the end of the Pleistocene. Pollen Zone II is

a transitional period marked by warming, drier conditions as oaks migrate up slope. Zone III is marked by increasing oaks and plants that produce TCT type pollen, suggesting an increase or further continuation of a warmer, drier climate. Zone IV with the presence of Douglas-fir is indicative of a cooler, more mesic climate (with a more balanced supply of moisture). Note that oak values increased until approximately 3,000 years ago, when they started to decline.

A-M Lake Pollen Data

A-M Lake is a small (approximately 1 acre) eutrophic pond between Alder and Maple Creeks on the southwestern slopes of Hammerhorn Peak at an elevation of 3,320 feet above sea level. The lake has no official name but was termed A-M Lake for ease of discussion in West's report (1991:1).

The pollen sample consisted of one core extending to a depth of 284 cm. A radio-carbon date of 1,630 B.P. (± 180) was obtained from a sample at the 177-187 cm level. The age determination and sedimentation rates indicate that the bottom of the core dates to about 2,500 B.P. Pollen preservation was good, and *Pinus* was the most abundant pollen type in the sample. Douglas-fir has low counts (>1 percent) in the lower portion of the core, but these increase through time (>18 percent) in the upper samples (West 1991:4-5).

As West (1991:9) notes, "[t]he trends in the pollen record of A-M Lake are consistent with other pollen records for the region." One of his most noteworthy observations is the increase through time in the distributions and numbers of Douglas-fir at all sample locations.

Paleoclimate of the North Coast Ranges

Pollen analysis has been instrumental in documenting the past climatic conditions of northwest California. Other lines of paleoclimatic investigations have also contributed to an understanding of earlier vegetation distributions and climate of the region.

For this study, the most important climatic data are for that period during which humans have inhabited the region, roughly a period of 5,000 to 8,000 years. Prior to this time, during the late Pleistocene and early Holocene, the climate of northwestern California was cooler than today. Evidence supporting this conclusion includes the documentation of glaciation during this period on the South and North Yolla Bolly Mountains, Anthony Peak, and other locations in the North Coast Ranges (Simons 1983:3.3).

During the mid-Holocene, the North Coast Ranges underwent a change to a warmer and possibly drier climate than that of today. This era, referred to by Dwight Simons (1983:3.13) as the Xerothermic Period, lasted from about 8,500 to 3,000 years ago. Simons (1983:3.13-3.14) summarizes some of the evidence for the Xerothermic Period in the North Coast Ranges (see also Barbour and Major 1977:187). This evidence includes vegetation types that are disjunct from the main areas occupied today by those species. For example, discontinuous stands of ponderosa pine extend southward from Clear Lake as far as Mount St. Helena. Isolated stands of the Gray Pine Woodland association are found north of Weaverville, in Hoopa Valley, and in the Mad River Valley to the west of South Fork Mountain.

Surveys for this study indicate that isolated stands of gray pine are also located within the North Fork basin (see also Griffin and Critchfield 1972:Map 56). These trees are found most often at lower elevations on dry south- and west-facing slopes, especially to the east of the North Fork of the Eel River. The more continuous distributions of gray pine in the North Coast Ranges begin in Round Valley and extend southward throughout the lower elevations of the interior Coast Ranges (Griffin and Critchfield 1972:89).

Taylor (1976:307) notes that it is likely that some Great Basin plant species extended their ranges into the mountains of the North Coast Ranges during the Xerothermic Period (or possibly during earlier xeric

periods), probably entering the area from the volcanic plateaus of northeastern California. An example in this area of a disjunct Great Basin species is western juniper (*Juniperus occidentalis*). Remnant stands of these trees are found in the Yolla Bolly Mountains. One isolated stand of juniper is located on Soldier Ridge in the Mendocino National Forest and is documented in the literature (Griffin and Critchfield 1972:Map 32). In addition, vegetation surveys conducted for this study have located several other isolated stands of juniper just to the east of the North Fork basin along Powell Ridge, the Shell Mountain area (including an oak-juniper woodland adjacent to Mud Lake) and near Ant Point. Furthermore, one lone tree, isolated from any other stands of juniper, was located in the Littlefield Creek drainage of the North Fork basin. These stands are mostly at higher altitudes, on well-drained and exposed southwest-facing serpentine soils (except for the lone tree in a glade adjacent to Littlefield Creek). These are the only documented occurrences of western juniper in the Coast Ranges. The closest area in which this species grows today is in Scotts Valley west of Yreka (Griffin and Critchfield 1972:21).

Further evidence for the extension of Great Basin species into the Coast Ranges includes a single grove of aspen (*Populus tremiloides*) that still survives in the vicinity of North Yolla Bolly Mountain (Griffin and Critchfield 1972:32). Another tree species, fox-tail pine (*Pinus balfouriana*), has disjunct populations in scattered remnant stands in the Yolla Bolly and Klamath Mountains and in the southern Sierra near Mount Whitney and portions of the upper Kings River and Kern River drainages (Griffin and Critchfield 1972:2; and personal observation).

A General Model of Past Climate and Vegetation for the North Coast Ranges

The pollen and climatic data for the North Coast Ranges, as analyzed by West have been presented as a generalized model (West 1988:8-9; 1990, 1993). This model suggests that, during the Pleistocene and early Holocene, the climate of the North Coast Ranges was cooler and more continental than today, with a weak subtropical high in July and strong westerly flows. During the next period, referred to as the Xerothermic and lasting from approximately 8,500 B.P. to about 3,000 to 2,500 B.P., climatic conditions changed to milder winters and warm, possibly drier, summers, probably persisting somewhat longer than those of today. Some plant species moved up slope as much as 1,000 feet (300 meters). In addition, some species of oaks and other more xeric species migrated further to the north and west. [It should be noted that not all researchers are in agreement that the climatic conditions present during this period should be referred to as the Xerothermic (personal communication, G. James West, Archaeologist, USDI Bureau of Reclamation).]

After the Xerothermic Period and beginning approximately 2,500 to 3,000 B.P., stronger maritime conditions began to prevail and the climate of the region began to change from a warmer regime to a cooler, moister one. This change, which resulted in a climate similar to that of today, has been documented in vegetation shifts in the pollen record discussed earlier. Temperatures dropped an average of 1.3 to 2.1 degrees centigrade, and plant zones began to shift down slope and to the south and east. Douglas-fir began to increase in numbers and distribution. This change in climate also had a significant effect on the vegetation associations and mix of species within the North Fork basin.

Vegetation Changes and Climate from 1865 to the Present

The entire ecosystem of the North Fork Region has changed dramatically since the beginning of the historic period. As noted earlier, one of the most significant changes was the increase in the number and distribution of Douglas-fir. Vegetation surveys indicate that some mature Douglas-fir were growing

within a majority of the oak woodland areas prior to 1865 (69 percent or 4,163 acres of oak woodland stands in Sub-area 1 on Map 2 contained some mature Douglas-fir). Those trees that had managed to survive periodic fires and grow to maturity numbered as many as several per acre in some areas. Natural and anthropogenic fires suppressed the natural proclivity of the Douglas-fir to propagate, thus maintaining the oak woodlands at the sub-climax stage. With the cessation of aboriginal burning, these trees provided the seed for the young Douglas-fir stands of today.

There is little evidence to support the hypothesis that a dramatic change in climate during the last 140 years has precipitated these changes. The coincidence of climate-induced changes to vegetation associations occurring concurrently with a radical shift in land-use patterns during the historic period is unlikely. It is more likely, as documented in this study, that changes in the distribution of vegetation types within the North Fork basin can be attributed to differences in land-use practices between the prehistoric and historic periods.

Chapter 8
Integrating Historical Data on the Environment with the Cultural Record

This portion of the study synthesizes data on the historical environment of the North Fork basin with the area's ethnographic record. This synthesis should provide insight into the procurement and use of natural resources by the aboriginal peoples of the region. Ultimately, this information will be useful in interpreting and providing a context for the region's archaeological record.

First, a catchment analysis is presented that integrates regional data on pollen analysis and paleoclimatic data with the basin's historical record of the environment to formulate a dynamic (diachronic) model of the environment for the prehistoric era in the North Fork region. In effect, this catchment analysis delineates the potential resources and food-gathering opportunities available to the aboriginal population at various times and in a changing environment. The catchment model permits researchers, as Richard Gould (1975:153) notes, to "...examine the universe of edible resources in this region from the point of view of how human beings must organize their movements, technology, and social groups in order to collect [these resources] effectively."

An overview of the ethnographic data for the region as related to the kinds of natural resources utilized by the Wailaki and Lassik follows the catchment analysis. In light of the resources outlined for the North Fork catchment and the region's ethnographic record, the final part of this text presents suggestions on potential site settlement patterning and the kinds of archaeological sites likely to be found in the North Fork region.

A Diachronic Catchment Model for the North Fork Basin

A catchment analysis model is a useful way to organize the environmental data needed to analyze prehistoric settlement patterns and subsistence activities. Kent Flannery (1976:19) defined a catchment as "...the zone of resources, both wild and domestic, that occur within a reasonable walking distance of a given village." More generally, it can be defined as "...a method of regional [environmental] analysis designed to examine prehistoric site locations and land-use patterns" (Francis and Clark 1980:97).

To date, much of the work applying catchment analysis models to the archaeological record has consisted of examining the environmental context of a single site or group of related sites (Vita-Finzi and Higgs 1970, Flannery 1976:95-103). Within the North Coast Ranges, Dwight Simons (1983) has conducted this type of catchment analysis for a series of sites located on Pilot Ridge and for a site

located to the east of Round Valley on the Black Butte River (Simons 1986). Simons (1983:3.35) has summarized the major criticisms of the catchment theory as it has been applied to human populations and to the interpretation of the archaeological record. Criticisms relevant to this portion of the current study include:

1. the use of present day environmental conditions and use patterns as a key to the past,

2. failure to adequately consider seasonal variation in resource availability and productivity,

3. failure to consider that catchment models often represent static, synchronic views of subsistence behavior and the ecosystem.

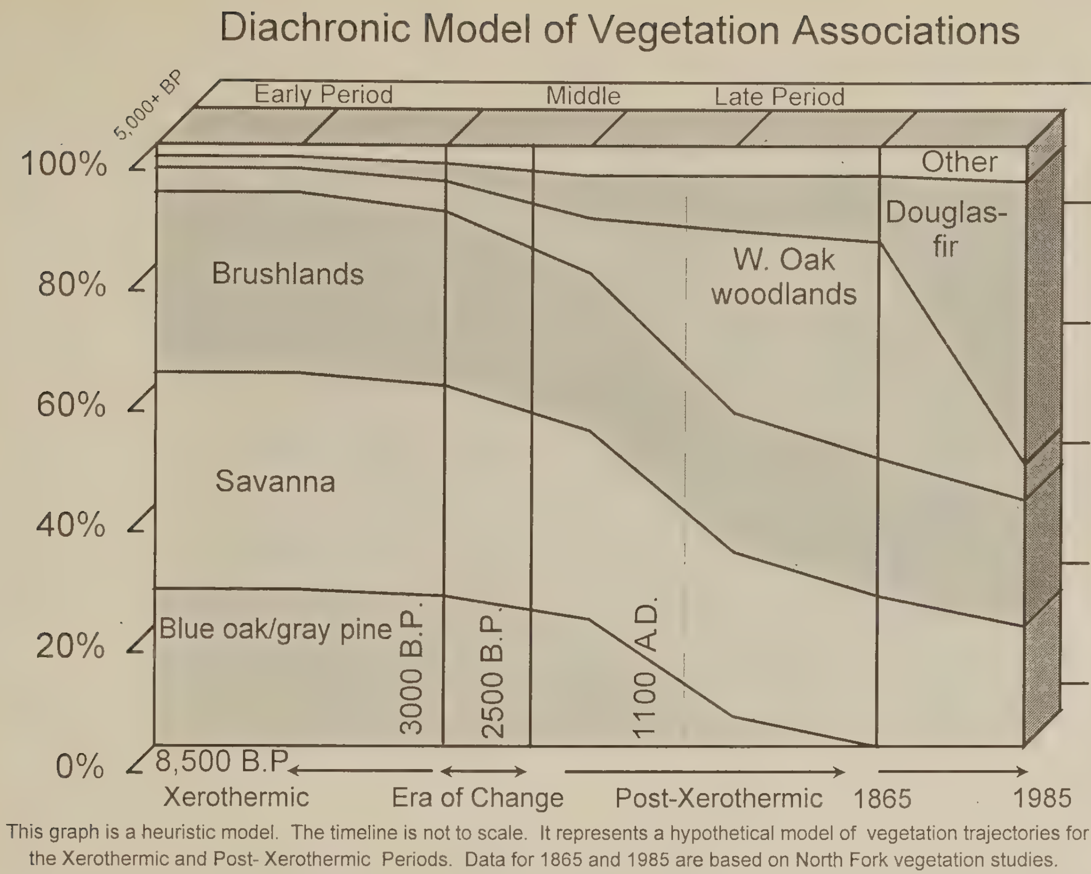
Because of these criticisms, the catchment model for the North Fork basin takes into account environmental change resulting from land-use practices during the historic period. Seasonal variability of the resource base is also integrated into the model. Moreover, the model also accounts for the temporal dimension during the prehistoric era by using pollen analysis data and paleoclimatic data. This temporal dimension is important because the availability of specific plant and animal species as potential subsistence resources has varied significantly, in response to the changes in climate and vegetation communities, since the beginning of the Holocene. Such variability has implications for human populations since the availability of subsistence resources and their distribution across the landscape should be reflected in the archaeological record both temporally and spatially.

In the formulation of this catchment analysis, an effort was made to consider cultural variables that might also have influenced the evolution of the region's ecosystem. There is an intrinsic relationship between the environment and the land-use activities and food-gathering strategies of prehistoric populations. Although the environment has influenced human land-use activities, cultural variables including anthropogenic fire and the intensity of food-gathering activities have, in turn, affected the region's ecosystem. Hunter-gatherers were far more than passive observers of the ecosystem within which they lived. A dynamic existed between the potentialities of a particular environment and the land-use activities of its human inhabitants.

Users of the catchment analysis model should remember that subsistence strategies and site settlement patterning are not entirely determined environmentally. Technological, social, and other cultural factors also play an important role in the formulation of settlement and food-gathering strategies (see Keter 1993).

The catchment area for this study is defined by the North Fork drainage; the model uses the 1865 baseline data presented earlier on vegetation, wildlife, and anadromous fish. These data are then placed within the parameters set by the North Coast Ranges paleoclimatic and pollen data so that a diachronic model of the North Fork basin is created. Numerous factors must be considered when applying paleoclimatic and pollen data to the North Fork basin from the various locations sampled by James West in the North Coast Ranges. These factors include differences in location—altitude, latitude, and distance inland—between the North Fork region and the areas of the pollen samples, as well as in local conditions such as soils, exposure, and micro-climate, all of which can affect the distribution of vegetation associations.

Shifting regional patterns in climate were subtle and probably occurred over long periods. Significant changes in vegetation distributions in response to the changing climate probably took place even more slowly. Graph 4 presents a hypothetical model of the long-term trajectories of the plant communities found within the North Fork basin; it is based on vegetation survey data, historic environmental studies, and paleoclimatic data. Development of a catchment analysis for the prehistoric era is necessarily generalized, and the time-frames presented below are approximate. This portion of the study only begins to organize environmental variables into



Graph 4: *Diachronic Model of Vegetation Associations*

a coherent model that can then be used to help interpret the prehistoric record of the North Fork of the Eel River region.

Xerothermic Period (8,500-3,000 B.P.)

During the Xerothermic Period, plant communities in the basin moved up slope about 300 meters in altitude and the temperatures were about 1.3 to 2.1 degrees centigrade warmer than today (West 1983a:3.19), resulting in somewhat warmer, drier summers with a longer dry season. With longer, drier summers, the oak species currently found in Round Valley (15 air miles to the south) and to the east in the Sacramento valley (at the same latitude) probably would have extended their range northward and westward. The vegetation associations during this era would have been similar to the more open Blue Oak/Gray Pine Vegetation Type (Küchler 1977) found today in the Coast Range foothills along the western edge of the Sacramento Valley and to the south in portions of Mendocino, Napa, and Sonoma Counties. Gray pine were more abundant than today, and the oak savanna (dominated by blue oak/gray pine) and savanna vegetation associations were major components of the environment (see Graph 4). Natural fire, and possibly toward the end of the Xerothermic Period, anthropogenic fire, would have occurred periodically, helping to maintain or encourage these vegetation associations.

During the Xerothermic Period, a migration of plant species northward for only 50-70 miles would have produced a species mix very different from that which exists today. A useful analogy, for modeling the past environment of the basin, is to compare it to an area existing today that has climatic conditions similar to those which might have been found in the basin during the Xerothermic Period.

A movement up-slope or down-slope of 300 meters by plants in response to climatic change is, relatively speaking, equal to a distance north to south of about 140 miles. Therefore, by examining vegetation associations present today about 140 miles to the south (with some attention given to soil types and historic land-use factors), and at the same altitude and inland location, one can gain some insight into the kinds of vegetation communities likely to have existed at lower elevations within the North Fork basin during the Xerothermic Period.

The San Francisco Bay area is about 140 air miles south of the basin. There, the vegetation associations are influenced by their proximity to the Pacific Ocean and San Francisco Bay. For purposes of comparison, therefore, a slightly more northerly location was selected for study: the northern portion of Napa County southwest of Lake Berryessa. This area is approximately 110 air miles to the south of the North Fork basin. Here, vegetation communities at 1,500 to 3,000 feet above sea level are quite different from those growing at the same altitude within the North Fork basin. At the beginning of the Contact Period (the mid-19th century), both locations had extensive areas of savanna, oak savanna, and oak woodlands. In the Lake Berryessa area, however, the oak species were different. In this region, there is also a significant decrease in the distribution of Douglas-fir, which are limited to the highest elevations and to areas with topographical shading (usually north-facing slopes).

In northern Napa County, white oaks are uncommon and are found only in disjunct populations at a few locations and at relatively higher altitudes than within the North Fork basin. The most common oaks in the Napa region are California live oak (*Quercus agrifolia*), valley oak (*Quercus lobata*), blue oak (*Quercus douglasii*), and black oak. Today, live oaks are found as far north as southern Mendocino County (Griffin and Critchfield 1972:34). The northern limit of valley oaks in the Coast Range is near the Trinity County line (Griffin and Critchfield 1972:Map 74). Valley oaks are not restricted to alluvial soils and can be found on open savanna and broader ridgetops directly to the east of the North Fork basin in Tehama and Shasta Counties (Griffin and Critchfield 1972:36). Blue oaks are found only a few miles to the south of the basin in the hills directly to the north of Round Valley. One remnant blue oak stand is located in Trinity County east of Redding in the Browns Creek/Reading Creek area (Griffin and Critchfield 1972:35).

The main characteristic of these oaks and the associated vegetation is that they are better adapted to a slightly drier and warmer climatic regime with a longer dry season than are the white oak woodlands. In addition, the number of trees per acre for these more xeric oak species is, generally, not as great as that of the white oak vegetation association type (Baumhoff 1963:165).

In view of these vegetation associations, during the Xerothermic Period the North Fork basin at lower altitudes would probably have been composed of extensive oak woodlands (primarily black oak, blue oak, valley oak, and gray pine), some scattered ponderosa pine, large areas of oak savanna (grasslands with only a few oaks per acre), and savanna grasslands. On areas with poor soils, especially with southern exposure, gray pine, manzanita, and other brush species probably predominated (see Graph 4). Douglas-fir and the other species of the Mixed Evergreen Forest type were probably only a minor component within the basin, limited at lower elevations to some north slopes and other locations that provided topographical shading and conservation of soil moisture. Most Douglas-fir were found above 3,500 to 4,000 feet. White oaks were not common within the basin, especially at lower elevations. The range of white oak is limited by rainfall: this species needs 4 to 10 inches during its growing season, which extends from April to September (U. S. Department of Agriculture 1965:596). Today, white oak in the Coast Range extends south to central Sonoma County, with disjunct populations extending even further south. For example, there are two small populations of white oaks in the Santa Cruz Mountains (Griffin and Critchfield 1972:100). Most of these oaks are found in the cooler, more mesic micro-environments of that region.

At higher elevations, in the Yolla Bolly region, more arid winters favored the growth of western juniper, fox-tail pine, and aspen. These tree species had a wider distribution than they do today, extending north to Scotts Valley along the interior of the Coast Ranges and Klamath Mountains.

It is not clear how the Xerothermic Period affected the grasses and forbs (see Appendix II, Table II-A) growing in the savanna and oak woodlands. A slightly warmer and longer dry season may have affected the species mix [as is evident for the species growing to the east and south today—see Beetle (1947) for distributions of grass species]. However, some species of perennial bunchgrasses (such as *Stipa* spp.) probably predominated in the region. Clovers and other "greens" (see Appendix II, Table II-E), and bulbous plants (see Appendix II, Table II-F) may also have been affected to some degree by the longer drier summers. Oak acorns, also an important food resource for both humans and some animals, were less abundant than they are today because of the decrease in extent of the oak woodland communities and the increase in the extent of the savanna grassland communities (see Graph 4).

Whether this reduction in acorn availability influenced or was a limiting factor to human occupation is unclear. Both the valley oak and the blue oak produce abundant acorn crops and are highly ranked as preferred species for native use (Baumhoff 1963:163). Blue oaks, however, produce an abundant acorn crop no more than 1 out of every 3 years (Baumhoff 1963:165). Moreover, regional models and artifact assemblages suggest that acorns were not a major food resource during the Early Period (prior to about 2,500 B.P.).

The climatic conditions and vegetation associations within the North Fork basin during this period would have affected the habitats of both terrestrial and aquatic fauna. For this study, the most important species of animals to discuss in relation to aboriginal subsistence activities are deer and anadromous fish.

Today, most deer leave the North Fork drainage during the long hot summers. They tend to travel up-slope to summer range (Burton n.d.:30) in the Yolla Bolly Mountains, the Round Mountain/Lassics region, South Fork Mountain, and other locations above 4,000 feet. Because vegetation moved up-slope approximately 1,000 feet in response to warmer temperatures during the Xerothermic Period, the summer deer range during that period was probably also somewhat higher than today. This rise in altitude would have reduced significantly the amount of habitat in this region available for summer range (many of the peaks and ridge lines in the basin including Jones Ridge, Mad River Ridge, and Haman Ridge are between 3,500 and 4,000 feet). The reduction in summer habitat and concentration of deer at higher altitudes (probably in areas above 4,500 feet) may help to explain the presence of so many Early Period sites at higher altitudes in this region—for example, Government Flat, Estle Ridge, Soldier Ridge, South Fork Mountain.

Whether the reduction in summer habitat was a major factor in limiting the size of the deer population is unknown. However, in view of the reductions in both adequate summer habitat and the size of the fall acorn crop, the deer population was probably somewhat smaller during the Xerothermic Period than during the ethnographic era.

As noted elsewhere in this study, elk were not present within the North Fork basin during the historic era. Because of the even warmer temperatures of the Xerothermic Period, few if any elk probably inhabited the North Fork basin at that time. The possibility of elk summering at higher altitudes in the region must be considered, however, as a reason for the high density of Early Period sites on some of the higher elevation ridges and mountains of the North Coast Ranges.

Because of the warmer, longer, and drier summers (and in all probability diminished yearly rainfall and snowpack) during the Xerothermic Period, stream flows would have been reduced within the basin. The density and distribution of the riparian vegetation would probably have also been reduced. In view of the critical need for cold water temperatures and adequate water flows to maintain critical summer habitat, it is likely that there was a signifi-

cant reduction in the number of anadromous fish within the North Fork basin. For this reason, one can hypothesize that the availability of fish as a food resource would have been limited during this period. The number of perennial springs in the region would probably also have been reduced, influencing both the distribution of deer and other species of wildlife and the selection of locations for temporary seasonal camps and villages.

Post Xerothermic Period (3,000-2,500 B.P. to 1865)

By about 3,000 to 2,500 years ago, the distribution of plant species and vegetation associations began responding to the more maritime weather patterns and associated changes in climatic conditions that began to dominate the northwestern California region. White oak and Douglas-fir began to move down slope and spread across the lower elevations of the basin as the more xeric species of oaks retreated to the south and the distribution of the savanna and blue oak/gray pine woodland vegetation types began to decline (see Graph 4). It is likely that an extended period (measured in centuries) was needed for vegetation associations to respond to the changing climatic conditions.

Several research papers [for example, Cole (1985:289-303), Lewin (1985:165-166), and Ritchie (1986:65-74)] have discussed the response of vegetation to changes in climate. They suggest that, once established, vegetation associations tend to maintain themselves long after suitable conditions for their establishment have disappeared. Thus, it is likely that vegetation distributions within the North Fork basin did not simply change overnight in response to changes in the climate. Rather, an extended period was needed for the white oak woodlands to become established and for conditions to become appropriate for any major succession of the area to Douglas-fir. (As noted earlier in this study, the white oak association in the basin is the seral [intermediate] stage for climax-growth Douglas-fir forests).

Natural fire also played a role in slowing the rate of change taking place within plant communities in response to the moderating climate. Sometime during this era, aboriginal land-use activities (including anthropogenic fire and resource procurement) became major factors influencing the environmental dynamics of the region.

During this period, the change in climate resulted in more summer habitat for deer. Fall acorn crops may also have become more productive because of the change in oak species to the denser stands of white and black oaks and their increased distribution within the basin (see Graph 4). These improved conditions may have contributed to an increased deer population. It is likely that grasses, forbs, bulbous plants, and other plant species also responded to changes in both climate and distribution of oak species.

With a more maritime climatic pattern influencing the region, stream flows during the dry season increased. Moderating climatic conditions (shorter dry season, reduced evapotranspiration, possibly increased precipitation) also provided for increases in groundwater flows and the number of live springs in the basin. At lower altitudes, along the stream courses of the region, habitat improved for anadromous fish species, and the availability of this resource probably increased over time. These changes in the environment and the resulting increase in the availability of subsistence resources would have made this area more attractive for permanent habitation by humans.

Chapter 9
A Catchment Model for Resource Procurement and Use During the Ethnographic Period

During the ethnographic period, the North Fork of the Eel River basin was inhabited by the Athabascan-speaking Wailaki. Linguistic data (Whistler 1979) suggest that they may have inhabited this region for nearly a thousand years. (In this study, the "late period" after approximately 1100 A.D. is considered to be culturally contiguous with the ethnographic era). The Pitch Wailaki occupied the southern portion of the basin. The northern part of the basin, south to about Rock Creek, was home to people traditionally classified by ethnographers as the Lassik. Culturally, there were few differences between these two groups. A review of the ethnographic literature and the original field notes of the ethnographers who worked in the region indicate that the Lassik were in essence the northern communities of the Wailaki (Keter 1993).

Elsasser (1978:194) has summarized the most recent population estimates for the Wailaki and Lassik. The estimated population during the ethnographic period for the Lassik was 1,411 and for the Wailaki it was 2,760. These estimates encompass all Lassik and Wailaki territory and extend considerably beyond the North Fork basin. No population data specific to the North Fork basin exist. However, given the relative size of Lassik and Wailaki territory and the number of village sites identified by Goddard (1923, 1924), it is estimated that approximately one-third to one-half of the Lassik population and approximately one-third of the Wailaki population either resided or spent a significant portion of each year within the North Fork of the Eel River basin. Thus, the total number of southern Athabascans inhabiting the basin for at least a portion of each year is estimated to have been around 1,300 to 1,500.

In the future, after additional site inventory surveys are undertaken within the basin, it is anticipated that the environmental data presented in this study will be integrated with more refined population estimates to produce a comprehensive overview of the relationship between population density and the potential resource subsistence base. What can be inferred from even this preliminary population estimate is that a relatively large population inhabited the North Fork basin during the ethnographic period.

The Lassik and Wailaki were related through both cultural and social ties (including marriage and kinship) as well as through the need to cooperate in formulating and coordinating resource procurement strategies within the North Fork region. Each community had its own chief, and families had specific claims to hunting, fishing, acorn-, and seed-gathering locations. During times of need, families would share resource gathering locations with extended family members, even those living in distant villages. Visitors from other communities provided the opportunity to share information about the location and availability of resources.

Lucy Young, one of the primary informants on Wailaki culture, indicated that this was an important topic whenever people got together to visit. The following paragraph is quoted from notes taken by her husband, Sam Young (of Wintu descent), and is unedited [from Essene's (n. d.) field notes]:

> ...if a visiter comes to the camp the old folks make the children get back out of Sight of the visiters.... someone of the old folks will spread a deerskin or something for the visiter to sit down....after Setting a while they give them something to eat then they will begin telling the news...the greater part of their talk will be about hunting and fishing and gathering seed of different kind, and of acorns of different kinds, and the most and best kind. and the best Places to get some nice fat deer. and the best places to catch a lot of fish to dry....

Very little ethnographic data exist concerning the subsistence activities of the southern Athabascans. [See Keter (1993) for an overview of past ethnographic research in the region.] The available information clearly indicates that they were experts at exploiting an astounding variety of plants and animals for food and other subsistence needs. In the late 19th century, V. K. Chestnut (1974) recorded the use of plants for medicine and food by the Indians living at the Round Valley Indian Reservation (including the Wailaki and Yuki). Nearly every plant in the region had a specific use as a food or medicine (or both). Chestnut (1974:289) chronicled the use of hundreds of plants and was so inspired by the Indians botanical knowledge that he wrote, "the inventive genius developed by these Indians, as a result of untold years of experience, is truly remarkable." Chestnut (1974:298) was particularly impressed with their use of plants for medicine and wrote, "medicine has much to learn from the Indians." He also noted that one plant, cascara (*Rhamunus purshiana*), that was used by the Indians as a medicine was at that time in general use by the medical community and was prescribed as a cathartic (Chestnut 1974:298).

The extensive and profound knowledge that hunting and gathering peoples have concerning their environment can best be illustrated by ethnographic analogy. During the 1980s Jared Diamond studied the *Fore*, a hunting and gathering people living on the island of New Guinea. During his field studies, Diamond was astounded by the taxonomic abilities of the *Fore*. In their small forested territory they could name 16 frogs, 110 birds, 15 small flightless mammals, 20 large mammals, 2 bats, and 17 lizards and snakes. They could describe each species, what they sounded like, their habits, and whether they were good to eat. Diamond (1989:16-23) writes of an experience in which his hosts collected mushrooms for dinner. He warned that many kinds of mushrooms were poisonous and extremely difficult to distinguish from the edible species. His hosts asked indignantly why, after they had identified so many plants and animals, that he thought they would be so stupid as to confuse safe and poisonous mushrooms. They then went on to name 29 kinds of edible mushrooms and where they could be found. Diamond (1989:23) writes that "even after years with the *Fore*, I didn't come close to exhausting their taxonomic knowledge."

An Overview of Seasonal Subsistence Activities

The following section presents a generalized overview of the subsistence activities of the groups in the North Fork region as based on the limited ethnographic data (primarily Essene, Goddard, Merriam, and Foster, both published and unpublished data). Refer to Appendixes II, III, and IV for a complete overview of the natural resources available within the North Fork basin.

In the North Coast Ranges during the ethnographic period, subsistence resources were so abundant that usually it was not necessary to travel long distances to collect them (Chestnut 1974:296). Although hunting and fishing provided a major part of the subsistence base, plants, especially acorns (and, in the North Fork basin gray pine nuts), were the most important food resources used by inhabitants of the region (Essene 1942:55).

The Wailaki and Lassik practiced a form of what has been termed the seasonal round (also referred to in some studies as transhumance). This subsistence

strategy involves movement through the environment across one's territory in order to procure resources as they become seasonally available. Such strategies might need to be modified because of drought, crop failure, or other events which might have reduced the availability of a particular resource. For example, deer populations can fluctuate greatly, and runs of anadromous fish are sometimes limited by unfavorable conditions. The scarcity of an important food resource probably resulted in an attempt to harvest lower ranked (less used) resources. (See Appendix V for an explanation of the rationale used in ranking the subsistence resources of the basin). Significant loss of a primary subsistence resource might result in hunger or even starvation.

Spring

After a long winter spent consuming primarily stored food, the inhabitants of the North Fork welcomed spring because it provided the opportunity to secure fresh plants. Plants collected this time of year included clovers (see Appendix II, Table II-E), the young leaves and stems of the sunflower, and other plants that were consumed as "greens" (clover was actually a generic term used by Indians during the historic period to refer to a number of herbaceous plants that were consumed this time of year [Chestnut 1974:359]). Essene (1942:84) wrote, "the earliest clover is eagerly gathered as greens [which] have been a conspicuously absent dietary item during the past season." Chestnut (1974:359) noted that clover was an essential element of the Indian diet and that in the Round Valley region, it was, "not uncommon to see Indians wallowing in the clover[,] eating it by the handfuls." According to Chestnut (1974:360), chemical analysis indicates that clover contains some essential food elements.

Although not documented in the ethnographic literature, an analysis of anadromous fish runs indicates that during March and early April steelhead and salmon were available for procurement. (This assertion conflicts with Goddard's [1924:217] statement that salmon did not migrate up the North Fork). By the end of April, anadromous fish runs were declining and eels were becoming available. Eel runs could last into mid- or late May in some years. Just how important a resource eels were in this region is unclear. They have been ranked in this study as a secondary resource (see Appendix V) because of their small size and because eels rapidly degenerate physically as they approach their spawning grounds.

Sometime in the spring the local communities began to leave their river villages and start their seasonal migration through their territory. In this region, the travel to exploit seasonally available subsistence resources was not over great distances; rather, it was a gain in altitude. The usual pattern was for each extended family to travel alone, although several families might be together for weeks at a time. At certain times of the year, many families would gather when a particular resource was abundant, not only for the purposes of collection but for an opportunity to socialize. Villages were not entirely abandoned during the summer, and occasionally families would return to villages for some period of time. In the North Fork area most upland locations in the Lassics/Round Mountain region and Middle Fork of the Eel River drainage were within a day's travel of the river villages. Cultural factors including socialization and the need to share environmental information on availability and location of particular resources were also considered in selecting the location of seasonal camps and may have been part of the impetus to leave winter villages (see Keter 1993).

By late March or early April, bulbous plants were maturing at lower altitudes and becoming available for consumption. Chestnut (1974:322) writes, "no where in the world is there more characteristic abundance and variety of bulbous rooted liliaceous plants than in California." There were a number of species of the lily family and the camus family in this region (see Appendix II, Table II-F). The bulbs of these plants are highly nutritious, have a nut-like flavor, and were collected in large quantities for roasting (or sometimes for boiling). They were collectively referred to by residents of the Round Valley Indian Reservation as "Indian Potatoes" and were dug up by women with a "potato stick" usually

made of mountain mahogany (*Cercocárpus* spp.). Consequently, many of the white settlers moving into California referred to the Indians of the state by the disparaging term of "Digger Indians" (Chestnut 1974:322).

The availability of large quantities of bulbous plants may have been the impetus for extended families from the smaller winter villages to gather during the spring in valleys at relatively higher altitudes (Hettenshaw, Kettenpom, and Hoaglin Valleys) for extended periods of time to partake in the bounty of the food resources and the opportunity for socialization (Goddard 1923:95). During June, the four day "camus" ceremony occurred in Kettenpom Valley. Each day and late into the night, a dance took place in a circular enclosure made of brush. This was considered by some informants the most important ceremony for the peoples inhabiting this region. One notable characteristic of bulbs is that they remain edible long after they first mature. It appears that some bulbs were processed and stored for winter consumption (see Appendix II, Table II-F, comments section).

In the North Fork basin and adjoining areas of southern Athabascan territory, deer travel in herds during the winter and spring, making communal hunting practical. [Local residents during the early 1900s could count over 1,000 deer in one day; see also Foster (1944:161)]. In the North Fork region, small herds of deer (15-25) can still be seen in April and May, especially in the grasslands on the south-facing slopes (personal observation). Deer were taken by the Indians in several ways, including with a bow and arrows. Rope snares were also used. With this method, the snares were placed across well-worn deer trails, and the herd of deer was driven up the hillsides. At this point, where the game trails came together and passed over a narrow gap in the ridgeline, a hunter would be located; he would shoot any deer avoiding the snares. When the deer were snared the hunters would kill them with stones and clubs (Foster 1944:161). In spring and other times of the year, a deer drive would be organized every 2 or 3 days; at such times there was no need to preserve meat because venison was abundant. Women and children helped in the butchering and carrying of the meat back to the camp or village (Curtis 1924:23-24).

Summer

As warm weather arrived and the hillsides began to dry out, the availability of plant resources at lower elevations began to decline. During this period, families began to migrate to their summer camps in the mountains. Interviews with local residents and Forest Service employees who work in the North Fork region also indicate that most deer leave the lower elevations in the summer when the heat becomes oppressive and many of the springs begin to dry up. In addition, plants mature later at the higher elevations, thus prolonging their availability for human use.

The ethnographic literature is not entirely clear exactly where summer camps were located in this region. Among the locations mentioned were South Fork Mountain, the head of the Mad River drainage, and the Lassics area. Other locations where large numbers of prehistoric sites suggest long-term summer occupation include, Hettenshaw Valley, Kettenpom Valley, Hoaglin Valley, and the Red Mountain area. (Although these locations are under 4,000 feet they have abundant water, bulbous plants, and other plant and animal resources available).

In contrasting the subsistence strategies of the southern Athabascans with those of the more riverine-oriented groups to the north (Karuk, Hupa, Yurok), early 20th century ethnographers may have overemphasized the seasonal round as practiced by the former. Some resources were available along the North Fork of the Eel River during the summer months. These included summer salmon, steelhead, resident trout, and suckers. Soap root was used to stun fish at this time of year, when flows were substantially decreased. Fish (especially steelhead) were also caught bare-handed by diving into large pools and catching them under the rock ledges (Interview 448). Furthermore, the perennial bunchgrasses began to mature by early-to-mid July, providing an important seed source. By August the grasses were mature; along with various other

mature seed sources (see Appendix II, Table II-A), they were used to make pinole, a major storable resource. Therefore, a number of individuals (for example the elderly) may have spent the entire summer in the river villages, while occasionally entire families may have returned for some period of time. Thus, the concept of entire villages traveling in search of food without regard for other social and cultural factors is an overly simplistic model for the inhabitants of this region.

During the summer when the people camped in the hills, they usually built brush shelters, or conical bark houses, or simply slept in the open (Essene 1942:12, 57). At the higher elevations, they killed deer and collected plants such as greens and bulbous plants. Another food resource maturing during the late summer was the fruit of the buckeye. This tree, however, is found only on the western side of the basin, extending over the ridge into the Zenia area. Grasshoppers were considered a delicacy (and are high in nutritive value); glades were sometimes burned to kill and roast these insects, which were immediately consumed.

Lucy Young indicated that summer was a "good time" because of the abundance of food resources available (Murphy n. d.). One of the most notable things about summer in this region was the wide variety of plant resources collected and the distance families sometimes traveled to obtain them and to socialize. Thus, summer may have been a time when no single food resource was available in large quantities at one location for an extended period. Instead, perhaps a wide range of secondary food resources occurring in limited amounts but relatively easy to secure was exploited across a wide area.

Fall

By late summer and early fall, local villages and extended families began to collect, prepare, and store food for the coming winter. At this time, the people probably returned to their winter villages so that transportation of foods for winter storage could be accomplished efficiently.

The most important food resource for the inhabitants of the North Fork region was acorns (Chestnut 1974:333). Lucy Young told Essene (1942:55), "If Indians ain't got acorns, it seem like he ain't got nothing." Tanoak (which were available in only limited areas in the North Fork region), white oak, and black oak acorns were the preferred species, with each being selected for a particular use (see Appendix II, Table II-F). Oak acorns ripen in early September and into October (personal observations indicate that in this region tanoak mature first, as early as late August, then white oak, and then black oak). Foster (1944:165) noted that for the Yuki, oak acorns were gathered for about 2 weeks after the first frost of the season, which generally occurred in late September. Acorns that fell to the ground were considered ripe and collected. In addition, men climbed the oak trees and knocked the nuts to the ground with long poles. The women then collected the nuts in large, conical burden baskets carried on their backs and supported by a wide band across their forehead so that both hands were free to collect acorns. A year's supply, about 400-500 pounds, was collected by each family. Each species of acorns was processed in a particular way.

Essene (1942:9,56) indicated that the inland southern Athabascans stored white oak and some black oak acorns outside in granaries that were bark-covered and elevated off the ground. Tanoak acorns (when available) and some black oak acorns were stored inside, reflecting the value placed on these particular species.

As noted earlier, acorns are very nutritious, and their caloric power exceeds that of chestnuts, Brazil nuts, and almonds (Chestnut 1974:335). Lucy Young indicated that among the *Sittenbiden* (the name of her community at Alderpoint), tanoak acorns were considered best for acorn soup and white and black acorns were best for bread (Murphy 1941:359). Use of certain species of acorns for bread and soup may have varied from tribe to tribe, because Curtis (1924:23) indicates that some of the Wailaki on the main Eel River used tanoak acorns to make bread.

Hazelnut (*Corylus cornuta* var. *californica*) was common to the canyons and hillsides of the region and the nuts were also collected by the sackful. Hazel branches and shoots were also used for basket materials. Another food resource available in the fall was gray pine nuts. Gray pines are found within the North Fork basin but not to the west. Lucy Young (Murphy n. d.) indicated that the "Pitch Indians" (*Che-teg-ge-kah*) were so named because they ate gray pine nuts. Sugar pine nuts were also a desirable product but were not common in the North Fork region. They were more common in the Yolla Bolly region to the east.

Grasses that began to mature in the summer, first on the south-facing slopes and at lower elevations, were collected and used, along with other seed resources such as sunflower seeds and tarweed, to make pinole. Next to acorns, pinole was the most important winter staple. During late summer and fall, the seeds of many species (see Appendix II, Tables II-A and II-B) were parched over live embers, shaken (winnowed) in a shallow basket, and reduced to a meal-like consistency referred to as pinole (Curtis 1924:23).

In the North Fork basin, the catchment analysis clearly indicates that grass seeds and black oak and white oak acorns would have been available adjacent to the riverine villages. Tanoak acorns were not readily available for the villages south of Rock Creek on the North Fork, nor are any groves located to the east of the river. Significantly, no anadromous fish were available in the North Fork basin during the fall and early winter. Deer began to move down into the lower portions of the basin by October and became available as a potential resource.

Winter

By mid-to-late November, winter usually arrives in the North Fork country. This was a critical time for the peoples inhabiting the region. Because they were dependent on stored food, there was always the danger of famine. Essene (1942:84) recorded one instance of a winter famine. It may have taken place, however, during the Conflict and Settlement Period. Merriam (n. d.) noted that, in the winter, families of each community were scattered along the river in small rancherias consisting of four to seven families living in two or three houses. Each house was inhabited by about 7 to 8 people. Winter houses were excavated to about 2 feet and were made of split pine slabs (probably ponderosa with cedar used when available because it splits easily), standing upright or sloping in at the top to form a conical house. [Some ethnographers recorded bark-covered houses; see also Curtis (1924) and Baumhoff (1958:176).] Trees were felled by means of elk-horn chisels and stone mauls—tools whose use made for a very tedious and laborious task. The logs were then cut into usable lengths by the same method and then split into slabs using elkhorn wedges.

In preparing for the long winter, families piled firewood in a dry place and filled their storage bins made of hazel and willow branches with acorns. Lucy Young (Essene n. d.) indicated that in addition to acorns, the main winter staples were grass seeds (for pinole), buckeye (uncommon in the North Fork basin but not at Young's home village at Alderpoint), dried meat, and dried fish (also available from the main Eel River). She said that this would provide enough food to last them until the "small potatoes" (bulbs) that grew in the early spring could be harvested.

As noted earlier, inhabitants of the village in Soldier Basin hunted hibernating black bears during the winter. The bear meat was smoked and used as a winter staple. Other groups in the North Fork basin may also have utilized bear meat, although given the relative population density, black bears would not have been a primary food source.

The catchment analysis also indicates that large numbers of deer wintered in the lower altitudes of the North Fork basin. In addition, by mid-to-late January both steelhead trout and chinook salmon began their yearly migrations up the North Fork of the Eel River. Thus, there were some important food resources available during at least a part of the winter. In view of the availability of significant quantities of deer and fish, famine was probably an exceedingly rare event in the North Fork region.

Chapter 10
A Diachronic Model of Resource Utilization and Settlement Patterning

As a capstone to the historical data on the environment, the catchment analysis, and the review of ethnographic data related to the procurement of subsistence resources, a model of resource utilization and settlement patterning for both the Xerothermic and the Post Xerothermic Periods concludes this study. This portion of the study synthesizes the data presented earlier into a model that provides a context for interpreting the archaeological record. In addition, some suggestions related to settlement patterns and site locations are offered. Presentation of hypothetical scenarios on settlement of the region, on the types of sites that might be found, and on the intensity of prehistoric settlement may enable these scenarios to be confirmed or rejected by future archaeological researchers.

Xerothermic Period (8,500 B.P. to about 3,000 to 2,500 B.P.)

The catchment analysis presented earlier suggests that the potential resource base available for human exploitation during the Xerothermic Period was much less than that of the ethnographic period. Some plant resources, especially acorns, were somewhat reduced in abundance (see Graph 4). Moreover, the animal species (deer and especially anadromous fish) that provided an important part of the food supply during the ethnographic era were not as plentiful. The less abundant subsistence resource base as well as a more xeric environment—including a reduction in the number of springs and live creeks, and perhaps, the drying up of the North Fork of the Eel River bed for much of the summer—probably reduced the overall desirability of permanent settlements in the North Fork basin.

As early as 5,000 B.P., small mobile groups practicing a forager subsistence strategy may have first entered the North Fork basin. With this subsistence strategy, little emphasis is placed on storage of food resources. Rather, "incongruities in the distribution of resources over time and space are solved by moving people from places of declining productivity to areas where foraging opportunities are enhanced" (Hildebrandt and Hayes 1993:115). This subsistence strategy requires frequent moves by entire social units resulting in homogenous settlement site structure (i.e., site-to-site variability) with similar generalized artifact assemblages (Hildebrandt and Hayes 1993:115). Thus, relatively small highly mobile groups inhabiting the Yolla Bolly region during this period probably visited the North Fork basin, perhaps on a seasonal basis, moving from location to location as various resources became available for procurement.

The collecting of plant resources has generally been considered of secondary importance during this era when compared to the ethnographic era. In the past, I have hypothesized (Keter 1988:12) that, because of the reduced resource base during the Xerothermic Period, there were few permanent residents within the North Fork basin. Additional research (including the excavations by the Bureau of Land Management at the Hull's Creek site and the Forest Service at nearby site CA-TRI-1297) as well as further environmental data since this hypothesis was first formulated continue to support this view.

Post Xerothermic Era (3,000 to 2,500 B.P. to about 1100 A.D.)

Only after the change to more maritime climatic conditions sometime after 3,000 B.P. was the North Fork region able to provide adequate resources and environmental conditions suitable for permanent occupation by a relatively large human population. Because of the length of time needed for significant changes in the environment to take place, conditions favorable to permanent human occupation in significant numbers probably did not occur until well into the Post-Xerothermic Period (see Graph 4).

As the amounts of harvestable subsistence resources (primarily deer and anadromous fish) increased, human occupation of the area probably also slowly intensified. Furthermore, with the onset of more maritime conditions, the number of perennial springs within the basin increased as well. Toward the end of this era, a collector subsistence strategy focusing on the most abundant natural resources including acorns, grass seeds, deer, and anadromous fish probably began to evolve.

Collectors store foods for some part of the year, usually in sedentary or semi-sedentary villages. Moreover, rather than a need like foragers for group mobility, collectors solve the distribution of resources across time and space by moving the resources to consumers—this results in fewer residential moves. For this reason, under the collector strategy intersite variability becomes more pronounced. There are, for example, residential sites (villages), as well as various other kinds of specialized sites used for the collection of specific resources.

This evolution to a more sedentary riverine-based population focusing primarily on resources within or directly adjacent to the North Fork region resulted in the need to intensify exploitation of plants, both for their nutritive value and for their ability to be stored for winter consumption. This intensification and diversification in the use of plants, coupled with a reduction in a forager oriented subsistence strategy, would have led to an increase in population. Over time, this dynamic between a more intensive use of natural resources and an ever-increasing human population could have been a significant factor influencing the evolution of the region's ecosystem.

One possible hypothesis for the evolution from a forager- to a collector-based economy within the North Fork basin is that prior to about 1100 A.D. the region was inhabited by the Yuki (or proto-Yuki). This suggestion is based on the proximity of the Yukian peoples directly to the south and on linguistic evidence suggesting that they predate Athabascan movement into the region. It is also possible that Penutian speakers (Wintu or proto-Wintu) from the east may have also utilized portions of the basin during this era. [See Keter (1993) for an overview on Wintu influence on Wailaki culture.] Perhaps arrival of Athabascan speakers was roughly contemporaneous with or could only have occurred sometime after the region became more productive as a result of the changing climate. The more intensified and diversified utilization of natural resources led to an increase in population and further specialization in the procurement of localized resources.

Post Xerothermic Period (After 1100 A.D.)

In view of the catchment analysis and the ethnographic data presented earlier, I now present some hypotheses about patterns of site settlement and resource utilization. Unlike the riverine-oriented cultures found further to the north in Hupa, Karuk, and Yurok territory, the location of village sites along the North Fork of the Eel River was apparently not based primarily on the abundance of anadromous fish. Although a primary resource (see Appendix V for a discussion of primary, secondary and tertiary resources), anadromous fish were limited to runs during a few months of the year, and there was no run in the fall. In the North Fork basin, village sites were clustered along the river for cultural and social reasons as well as environmental ones.

The main environmental reason, of course, was the lack of water at higher elevations, especially during the acorn-harvesting season in the fall. Thus, the clustering of villages along the North Fork [for example, the string of villages listed by Goddard (1924) as extending from the confluence of Hull's Creek north for about 2 miles] or the existence of a very large village (for example, the one at Soldier Basin) permitted a much larger social grouping (community) than would have been possible even at only slightly higher elevations.

Another reason village sites were located along the river was that it was below the snowline. The major valley locations away from the river—areas with relatively flat land such as Hettenshaw, Kettenpom, Hoaglin, and Mina—while below the permanent winter snowline at about 3,500 feet, often do have heavy snows for long periods making winter settlements undesirable. Another major barrier to year-around settlement in these areas is the lack of significant amounts of water during the late summer and fall. This may have limited their use to some degree.

During the spring, there was a great deal of social interaction among communities in Hettenshaw, Kettenpom, and Hoaglin Valleys. These valleys were important gathering locations for bulbs, a primary subsistence resource, as well as for secondary and tertiary subsistence resources including clovers and berries. Deer were also plentiful in these areas in the spring. In view of their relatively higher altitudes (2,500-3,000 feet) and easy access to nearby regions above 4,000 feet where deer summer over, these locations were perhaps inhabited by a large number of families for extended periods during the spring and summer.

On high-altitude sites used during the summer, the focus was on the hunting of deer and the procurement of a wide range of secondary and tertiary resources. Single-component sites containing flaked lithic material (primarily chert flakes) are common within the basin; they were probably used to process resources or as temporary encampments. Extended families probably did not inhabit these sites. Further complicating the formulation of a site settlement model for the region is the fact that some subsistence activities and areas of resource procurement may not be evident in the material record. For example, the use of digging sticks to harvest bulbous plants was a major activity, yet evidence of it will be lacking in the archaeological record.

Apparently, people sometimes returned to their river villages during the summer. Some secondary subsistence resources including summer steelhead and salmon as well as plant resources such as grass seeds and bulbs would have been available at this time. Perhaps some communities or extended families summered in the mid-altitude valleys previously mentioned as well as at Red Mountain Fields. The Round Mountain/Grizzly Mountain region (above 4,500 feet) may also have been the location of some major summer encampments. High-altitude sites east of the North Fork basin in the Middle Fork of the Eel River basin and the South Fork of the Trinity River region may also have been the location of extended summer settlements.

Conclusion

After studying and researching the environmental and cultural history of the North Fork of the Eel River basin for nearly a decade, I have concluded that there have been significant changes to the environment over the last century and a half. Nearly every part of the ecosystem has in some way been affected by the changes in land-use activities that have occurred since the beginning of the historic era. If our society is to make informed choices and recommendations on the management of ecosystems, it must understand the past biological, climatological, geological, and cultural processes that have helped shape the environment. Study of past environmental processes can also provide insights into the prehistory of a region by providing an environmental context for interpretation of the archaeological record.

In a survey of papers presented in the periodical *Ecology*, Hamburg and Stanford (1986:169-171) found that only 26 percent of these papers made any direct reference to previous land-use activities of the locations studied. As Hamburg and Stanford (1986:169) point out: "[K]nowledge of the historical patterns of anthropogenic disturbance is critical to an understanding of the patterns (or lack thereof) and processes of ecological systems." On the other hand, studies of prehistoric sites often include lengthy sections on the most minute differences in projectile point typology while glossing over or including a "laundry list" description of the contemporary environment.

I believe that researchers in both the biological and anthropological sciences need to break down the barrier that in the past has seemed to separate our respective fields of study. I also believe that a holistic multidisciplinary approach to ecosystems management is needed and that anthropology and its subdisciplines must be a part of this new approach. After ten years of studying both the past cultures and environments of the North Fork of the Eel River region, I have come to appreciate the interconnectedness of humanity and nature. By looking closely at one small river valley in northern California, I have learned that one cannot separate human influences on the environment from other ecological processes. Like it or not, humans are only a part of the ecosystem. Study of past environments has much to offer us in the way of insights on how to effectively manage natural resources. In the future, how humans choose to affect their environment and how they choose to manage public lands will, ultimately, tell us if we are listening to the lessons that history has to teach.

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Interviews

Interviews cited (379, 391, 395, 449, PCWA #2, 444, 445, 446, 448) are on file, Heritage Resources, Six Rivers National Forest, Eureka. Some of these sources are specifically cited in the text, while others provided general input to the document.

Personal Communications

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Anthropologists:

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Other Individuals Contacted:

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Appendix I

Key to Vegetation Association Classifications Used in Chapter 3

B	barren, little vegetation
Bbg	mostly barren, some brush species, grasses, live oak, gray pine
Bol	brush mix with some oak, live oak, or gray pine
Bf	brush, some Douglas-fir or gray pine, ponderosa pine
Bl	brush species only—including manzanita
Blo	poor or rocky soils, live oak predominates
Bps	poor laterite or serpentine soils, jeffery pine, manzanita and/or brush species present
Osx	xeric grasslands, some manzanita, digger pine or oak present
Oso	open grassland prairie
Os	grasslands with few oaks (under 10 per acre)
Osw	grasslands with approximately 10-30 oaks per acre
Osc	grasslands with some ponderosa pine, jeffery pine, or Douglas-fir
W	oak-woodland (over 30 oaks per acre)
Wc	oak-woodland with conifer present (under 10 per acre)
Wdf	oak-woodland, small Douglas-fir invading (under oak canopy)
Wb	oak-woodland, some brush species or xeric vegetation
Dfo	Douglas-fir have invaded stand of oaks and are closing canopy <50 years)
Dfy	Douglas-fir have recently broken through the oak canopy (>50 years)
Dfd	Douglas-fir have overgrown oaks which are mostly dead or dying
Dfb	some type of brush species and/or digger pine present
Xfw	Douglas-fir and oak mix in which Douglas-fir predominated prior to 1865
Xdf	mature stand of Douglas-fir (<150)
Xob	Douglas-fir (>150) with some brush species present
To	tanoak predominate

Appendix II

Plant Resources within the North Fork Region

Tables II-A, II-B, II-C, II-D

Grasses and Seed Producing Plants

Notes on Grasslands and the use of Seed Resources

The grasses of the North Fork basin were a rich source for edible seeds (Table II-A). Several perennial bunch grasses were probably abundant within the basin, including California oat grass, some species of *Poas* (possibly including *P. scarbel*), *Stipas*, *Melicas*, and *Festucas*. Many other plant species also provided a rich source of seeds (see Table II-B). For example, sunflower seeds were collected (Curtin 1957:11, Chestnut 1974:397) in the fall and were dried, pounded, and winnowed in a flat basket. Often, they were parched and blended with other grass seeds for pinole (Curtin 1957:11). One native informant noted that the harvest of seeds was extremely important to ensure an adequate winter reserve of storable food supplies (Hamann n.d.:16). Thus, storable seeds are ranked as a primary subsistence resource.

Tables II-C and II-D present those species of non-native grasses and other plants potentially available for seed procurement subsequent to the beginning of the historic era. They are presented to show both the adaptive responses made by the Indian people to the changing environment as well as to document for the record those resources not available during the prehistoric period.

The perennial grasses that predominated on the savannas and oak woodlands in the region matured (at the lower elevations) in July and August, but were most likely available for procurement as late as September and possibly into October for some species. With significant areas of savanna and oak woodland vegetation communities adjacent to village sites, fall collection of seed resources could be accomplished without traveling long distances.

Scientific names, where possible, are the most recent. Some of the names used by Chestnut (1974) are antiquated and were updated. The basic references used for this section are: Abrams (1923), Hickman (1993), Hitchcock (1971), and Munz (1968).

Plant Resources within the North Fork Region

Table II-A
Native Grasses

Many of these grass species provided edible seeds—maturation of the majority of these grasses was in mid-July to August.

Species	Common Name	P or A	Comments
Bromus marginatus@		P	Chestnut notes as native
Danthonia California	California oat grass	P	common precontact bunchgrass
*Deschampsia elongata**	slender hair grass	P	
*Elymus glaucus**	blue wild rye	P	
E. triticoides+@	beardless wild rye	P	squaw grass locally
*Festuca californica**	California fescue	P	
F. Idahoensis	Idaho fescue	P	
F. occidentalis	western fescue	P	
F. microstachys		A	rare
F. octoflora	six weeks fescue	A	
*Melica californica**	California melic	P	
*Poa scabrella**	pine bluegrass	P	
Sitanion hystrix@	bottlebrush squirreltail	P	*S. elymoides* Chestnut (1974)
*S. jubatum**	big squirreltail	P	
*Stipa lemmoni**	lemmon's bunchgrass	P	needlegrass locally
S. pluchra	purple needlegrass	P	

P or A: P=Perennial, A=Annual

* Identified in the North Fork basin by the author or Leitner and Leitner (1988).

\+ Identified on Mad River Ranger District, Six Rivers National Forest adjacent to basin.

@ Chestnut (1974) identified as used in or adjacent to basin by Wailaki.

Plant Resources within the North Fork Region

Table II-B
Native Plant Seed Resources Other than Grasses

Collected primarily for seeds for pinole--storable for winter use

Species	Common Name	Comments
Achyrachaena mollis@	blow wives	
Boisduvalia densiflora@	dense flowered B.	
Ceanothus spp.@+	deer brush	brushland species
Clarkia purpurea@	purple Godetia	dry slopes rare today
*Hemizonia luzuloefolia**@	hayfield tarweed	
Madia anomala@	plump seed madia	annual grassy slopes
M. sativa@	coal tarweed	annual
Nymphaea polysepala@	Indian pond lily	aquatic numerous seeds
Perideridia kelloggi@	Kellogg's yampah	
Plagiobothrys campestris@	popcorn flower	young leaves eaten as greens
Pogagyne douglasii@	Douglas' pogagyne	(var. *parviflora*)
Saliva columbariae@		annual
Thysanocarpus curvipes@ var. *elegans*)		mustard family grassy slopes
Verena hastata+@	blue vervain	
*Wyethia angustifolia**	sunflower	
W. longicaulis+	sunflower	used in region

* Identified in the North Fork basin by the author or Leitner and Leitner (1988).

\+ Identified on Mad River Ranger District, Six Rivers National Forest adjacent to basin.

@ Chestnut (1974) identified as used in or adjacent to basin by Wailaki.

Table II-C
Introduced Species of Grasses

At least some of these grasses were collected during the historic period. The seeds are often larger but less nutritious than native grasses.

Species	**Common Name**	**P or A**	**Comments**
Aira caryophyllea	silver hair grass	A	established 1870s
*Avena fatua**@	wild oats	A	established by 1850s
*A. barbata**@	slender oat	A	
*Briza minor**	little quaking grass	A	
Bromus commutatus	hairy chess	A	
*B. mollis**	soft chess	A	weed
*B. molloformis**		A	
B. racemosus		A	weed
B. rigidus+	ripgut grass	A	in Davy *B. maximus*
B. rubens	fox-tail chess	A	established 1870s
*B. tectorum**	downy chess	A	
*Cynosurus echinatus**	dogtail grass	A	
*Elymus caput-medusa**	medusahead	A	common locally
Festuca myuros	rat tail fescue	A	locally called squirreltail
*F. reflexa**		A	
*Gastridium entricosum**	nite grass	A	established 1870s
Hordeum leporimun		A	established 1870s
H. hystix+	mediterranean barley	A	established 1880s
H. leporinum		A	Chestnut misidentified as *H. murinum*
H. marinum+	barely grass	A	established after 1860
H. vulgare	barely	A	used in Round Valley
Lolium multiforum	Italian ryegrass	P	weed
L. temulentum	poison rye grass	A	
Madia sativa		A	established 1880s
Phalaris tuberosa+	(var. *stenoptera*)	P	established late
Poa annua	annual bluegrass	A	weed
P. trivialis+	rough bluegrass	P	

P or A: P=Perennial, A=Annual

* Identified in the North Fork basin by the author or Leitner and Leitner (1988).

+ Identified on Mad River Ranger District, Six Rivers National Forest adjacent to basin.

@ Chestnut (1974) identified as used in or adjacent to basin by Wailaki.

Plant Resources within the North Fork Region

Table II-D
Other Introduced Plant Species

These plants were used as food resources during the historic period.

Species	Common Name	P or A	Comments
*Erodium cicutarium**	red stemmed filaree	A	used as a green
E. moschatum	white filaree	A	after 1890 as a green
*Heracleum lantrim**	cow parsnip	P	*H. sphondylium* is native
Medicago spp.@	bur clover	A	used as a green
Rumex crispis@	curly dock	P	estimate very early seeds were used

P or A: P=Perennial, A=Annual

* Identified in the North Fork basin by the author or Leitner and Leitner (1988).

@ Chestnut (1974) identified as used in or adjacent to basin by Wailaki.

Table II-E
Clovers and "Greens"

Notes on the Use of Clovers and "Greens"

The ethnographic literature (Chestnut 1974:322, Parker 1988:3) indicates that in early spring, the gathering of clover was one of the most important subsistence activities for groups in this region of northwestern California. Clover actually was a general term used by the Indians in this region to refer to a number of herbaceous plants (Chestnut 1974:359).

The emergence of clover (and other leafy green plants) after the long winter was a much anticipated event. Most clovers (which contain large amounts of the vitamin C lacking in the winter diet) were eaten raw as a green, some were steamed (Curtin 1957:14). Stephen Powers (1976:235) noted that, "Clover is eaten in great quantities in the season of blossoms. You will sometimes see whole villages squatted in a lush clover-meadow[,] snipping it off by hooking the forefinger around it and making it into little balls."

The Wailaki held a Clover Dance each year. It was performed during the early spring (Powers 1976:118, Chestnut 1974:360). When Chestnut (1974:300) visited the Round Valley Indian Reservation in the 1890s to record plant use among the local Indian population, clover was still an important food resource. Frank Essene (1942:84) noted that during his research in Round Valley he was told that, "the earliest clover is eagerly gathered as greens have been a conspicuously absent dietary item during the past season."

Clovers would have been available at lower altitudes as early as mid-March and at higher elevations well into the late spring and early summer—possibly later at more mesic locations. Clovers have been ranked as a primary resource because of their importance in the aboriginal diet, their relative abundance, and their availability in the late winter and early spring when few other plants were yet available for use.

Clovers are often found in the savannas and oak woodlands and are especially common at more mesic locations.

Plant Resources within the North Fork Region

Table II-E
Seasonal "Greens"

Species that were probably found within or adjacent to the North Fork basin. Clovers and other leafy plants are referred to collectively in the literature as "greens".

Genus and Species	Common Name	Comments
Various plants used as greens		
Lupinus spp.	lupine	
*Montia perfolia**	miner's lettuce	
Traxicum vulgare	dandelion	
Vicia americana@*	peavine	
Clovers (all annuals)		
Trifolium bifidium decipiens@*		seeds make good pinole
T. cyathiferum@*		
T. eriocephalum		Davy (1902) found in oak woodlands
*T. fucatum virescense **		
T. microcephalum		
T. tridentatum		uncommon (Davy 1902)
T.variegatum @		

* Identified in the North Fork basin by the author or Leitner and Leitner (1988).

@ Chestnut (1974) identified as used in or adjacent to basin by Wailaki.

Table II-F
Bulbous Plants

Notes on the Use of Bulbs

In the North Fork region, bulbous species of plants (*Camas*, *Liliaceae*) apparently provided a major portion of the food resources for the Wailaki and Lassik during part of the year. Chestnut (1974:322) notes that, "no where else in the world is there a more characteristic abundance and variety of bulbous-rooted liliaceious plants than in California." These plants were an important resource to the aboriginal inhabitants of the North Fork basin. After the Contact Period, bulbs were referred to as Indian Potatoes (Chestnut 1974:327). Most species were cooked before consumption.

One species of bulb was especially important in the North Fork basin. This bulb (*Camassia leichtlinii*) was referred to by its Wintun name, *Ket' en*. This plant was found in great abundance in Kettenpom and Hettenshaw Valleys (Powers 1976:117). It's bulbs were dug up in June and early July using a digging stick. The bulbs were usually roasted, although sometimes they were boiled (Chestnut 1974:327).

In the early 1900s when V. K. Chestnut made his botanical survey, Kettenpom Valley (*Ket' en-chow* in the Wintun language for valley of the camus) was recognized as fine hog country because of the abundance of these bulbs. Pigs fattened better on the bulbs than on corn. Hoaglin Valley, an extension south of Kettenpom Valley, probably provided the same types of resources. (Hettenshaw Valley, Summit Valley, the Lake Mountain area, and the Mina area also contain significant colluvial flats within or adjacent to the North Fork basin). These locations, taken as a whole, total well over 2,000 acres and would have provided abundant seasonal resources for procurement of bulbous plants, clovers, seeds, and other subsistence resources. Numerous prehistoric sites have been identified at these locations; they were probably inhabited for a significant portion of each year, especially in the spring and early summer. For example, the abundance of these resources permitted many extended families to assemble during the late spring and early summer in Kettenpom Valley to collect subsistence resources and to socialize. During this time of year, bulbs of the various species were gathered in great quantities and a large feast was held (Essene 1942:84).

Some species of bulbous plants grew on the mountainsides and at higher elevations (for example, *Triteleia laxa*). Thus, bulbs could be collected at a number of locations, not just in the more obvious flat, colluvial valleys. Some species of bulbous plants were available for procurement as early as April (*Brodiaea laxa*). Furthermore, bulbs were still edible after remaining in the ground for long periods (through the summer and into the fall, although they would be harder to dig and collect at this time). Some bulbs were processed for winter storage by reducing them to a pulpy mass and letting them dry.

The bulbous portion of the soap root (*Chlorogalum premeridianum*), in addition to being used as a poison to stun fish in slow-moving water, was also eaten. It is a large tuber with a fibrous outer covering; the poison was apparently removed during cooking. This plant occurs above 2,000 feet and is common in the basin.

Because of their importance to the native, diet bulbs are ranked as a primary resource. They were also important because they permitted the gathering of large numbers of families and communities in one location for social interaction and cultural activities.

Plant Resources within the North Fork Region

Table II-F
Bulbs

Genus and Species	Comments
*Allium unifolium@^*	Indian onion
*Brodiaea pluchella^*	very sweet bulbs
B. laxa^@	abundant on hillsides, a desired resource
B. hyacinthina@	Chestnut's *Hespercordum capitalatum*--wild hycinith
B. coronaria@	Chestnut's *Hookera c.*
B. laxa@	Chestnut's *Triteleia laxa* available as early as April
Calochortus tolmiei@#	Chestnut's *C. maweanus*, excellent food resource
C. amabilis#	Chestnut identified as *C. pulchellus*
*Camassia leichtlini@**	Ketten bulb, found in great quantities in high valleys
*C. qumash@^*	blue camus also called common camus
Chlorogalum premeridianum@*	soap root
Fritillaria lanceolata@	Chestnut's *F. mutica*, not used for food
F. recurva#	This may have been misidentified by Chestnut as *Allium bolanderi*, which is very similar--abundant in region
*Lilium spp.**	not confirmed as food resource

@ Chestnut (1974) notes as utilized in or adjacent to basin

^ Curtin (1957)

* Identified in the North Fork basin by the author or Leitner and Leitner (1988)

Identified in a personal comunication with Orvel Ballantyne, botanist

Table II-G
Trees

Notes on Acorn- and Nut-bearing Trees

Oak acorns and nuts were the most important subsistence resources used by the Indians of this region (Chestnut 1974:333).

Oaks (*Quercus*)

Within the North Fork basin, the most common oak was the Oregon white oak followed by the black oak. Oak acorns matured in September and early October and were also a major food for deer, which consumed large quantities of acorns to put on fat to last them through the lean winter months. One of the most important reasons why acorns were used by humans to such a great extent was storability. Along with grass seeds, acorns provided the bulk of foods stored for use during the winter season.

Both white oak and black oak acorns are ranked as primary food resources. Significant areas of the oak woodlands are found at lower elevations in the North Fork region. Thus, most collecting could probably be done within a reasonable distance of winter villages.

Tanoak (*Lithocarpus densiflora*)

Tanoak were a preferred species of acorn for many of the Indian groups in northwest California. In the North Fork region, tanoak are limited to a few locations on the north-facing slopes in the northwest portion of the basin (Sub-area 3 on Map 2). In addition, some tanoak stands were identified at relatively higher elevations (above 2,500 feet) adjacent to the county road leading to the Hull's Creek site. Ranking of this resource is problematic. As it is much desired in those areas where it is found, it is a primary resource. However, because of its limited distribution in the North Fork basin, especially to the south of Rock and Salt Creeks, it might more accurately be ranked as a secondary resource.

Gray Pine (*Pinus sabiniana*)

The pine cones of the gray pine provided a nutritious seed. The process of collecting these seeds was labor-intensive (Chestnut 1974:308), but the seeds were valued, as was the gum that accompanies the pitch covering the seed cones. This pitch called *ju* by the Wailaki, was highly prized. Children chewed it much like gum.

Lucy Young (Murphy n. d.) noted that "Pitch Wailaki" was the name given to the Indians of the North Fork region because of the pitch they got on themselves when they harvested the gray pine nuts. These nuts

ranked as a secondary resource, but they may well have been a primary resource for some areas of the region, especially in the southern part of the drainage.

Hazelnut (*Corylus cornuta* var. *californica*)

Hazelnuts were available in relatively large quantities at higher elevations. Lucy Young (Murphy n. d.) noted that in the fall her people would meet on South Fork Mountain with the Wintu for a celebration timed to the maturing of hazelnuts. Hazelnuts were considered desirable, although they are not classified as a primary resource (because they were less abundant near the major village sites than oak acorns). For this study, they have been ranked as a secondary resource.

Table II-G

Tree Species used for Subsistence Resources

Genus and Species	**Common Name**	**Comments**
(Acorns and nuts)		
Corylus californica@*	hazel	
*Lithocarpus densiflorus**	tanoak	mostly limited to NW part of the basin
*Pinus lambertiana**	sugar pine	rare in basin; some stands located just to the east and south of the basin
*P. sabiniana**	gray pine	fairly common in the basin
*Quercus chrysolepis**	canyon live oak	common along the steeper rockier canyons
*Q. garryana**	Oregon oak or white oak	most common oak in the basin
*Q. kelloggii**	black oak	found in association with Oregon oak
Umbellularia californica@	buckeye	fruit is poisonous until processed
(Other uses)		
*Pinus ponderosa**	ponderosa pine	pitch was chewed; also used for medicinal purposes
Taxus brevifolia	Pacific yew	used for making bows; berries eaten; seed poisonous

* Identified in the North Fork basin by author

@ Identified by Chestnut (1974) as utilized in or adjacent to basin

Table II-H
Other Plant Species

Notes on Other Plant Species

Many other species of plants were used to provide variety to the aboriginal diet. Although most of these plants probably comprised only a small fraction of the diet they may have been important from a nutritional standpoint by providing for a balanced diet. Some of the more important species included wild strawberry, choke cherry, manzanita berry, wild black raspberry, thimble berry, elderberry, and wild plum. Various species were available for procurement throughout the late spring and summer; they were probably secondary and tertiary resources.

Table II-H
Other Plant species

Only those species are named that are cited in the ethnographic literature.

Genus and Species	Common Name	Comments
Fragaria californica@	wild strawberry	
Ribes californicum@	thorny gooseberry	
R. divaricatum@	straggly gooseberry	
Prunus demissa@	choke or bitter cherry	
*Rubus leucodermis@**	wild black or white-stemmed raspberry	special trip to mountains in July, also dried them for winter use (Chestnut 1974:355)
R. parviflorus@	thimble berry	
*R. vitifolius**	common blackberry	
*Vaccinum ovatum**	evergreen huckleberry	mesic areas NW part of basin
*Arctostaphylos manzanita@**	manzanita	July-Aug. berries used for cider, also ground for pinole—highly nutritious
*Prunus subcordata@**	wild or sierra plum	

* Identified in the North Fork basin by author

@ Identified by Chestnut (1974) as utilized in or adjacent to basin

Appendix III

Terrestrial Fauna of the North Fork Basin

Tables III-A, III-B, III-C, III-D
Terrestrial Fauna

Notes on Terrestrial Fauna

Terrestrial fauna contributed a significant portion of the subsistence resource base for the Wailaki and Lassik. The following Tables present a listing of the fauna potentially available for consumption in or near the North Fork basin. These Tables were developed by using current biological data from Forest Service scientists and recent studies applicable to this region. [See, for example, Marcot (1979) and et al. (1981).] Ethnographic data related to the use of particular species of animals was garnered from published ethnographies (Essene 1942, Foster 1944), as well as unpublished field notes (Essene n. d., Merriam n. d.). The ranking of each animal is based on the criteria outlined in Appendix V. This ranking is used in an attempt to quantify the relative amount that each species contributed to the aboriginal diet. The purpose of this ranking is to provide future researchers with quantifiable data on the subsistence resource procurement practices of the Wailaki and Lassik. This listing of fauna is by no means complete and it is anticipated further research will build on and modify this information.

Terrestrial Fauna of the North Fork Basin

Table III-A
Mammals

Common Name	Scientific Name	Habitat *	Rank +
Deer	*Odocoileus heminous*	W/S	1
Elk	*Cervus elaphus roosevelti*	--	6
Wolf	*Canis lupus*	--	6
Red fox	*Vulpes fulva*	--	6
Gray fox	*Urocyon cinereoargenteus*	--	4
Coyote	*Canis latrans*	--	4
Grizzly bear	*Ursus americanus*	W/S	4
Black bear	*Ursus arctos*	F	3
Mountain lion	*Felis concolor*	--	4
Bobcat	*Lynx rufus*	--	4
Mink	*Mustela vison*	--	6
Fisher	*Martes pennanti*	--	6
Weasel	*Mustela* spp.	--	4
Wolverine	*Gulo gulo*	--	6
Otter	*Lutra canadensis*	--	4
Striped skunk	*Mephitis mephitis*	--	4
Wood rat	*Neotoma*	F	3
Other rodents: voles, chipmunks, mice, etc.	*Rodentia* family	ALL	3
Cottontail rabbit	*Sylvilagus* spp.	B/W	3
White-tail jackrabbit	*Lepus townsendii*	B/W	3
Black-eared jackrabbit	*Lepus californicus*	B/W	3
Squirrels	*Citellus beecheyi*	ALL	3
Porcupine	*Erethizon dorsatum*	--	6
Badger	*Taxidea taxus*	--	6
Racoon	*Procyon lotor*	R/F	3
Rintail cat	*Bassariscus astutus*	--	6
Pine martin	*Martes americana*	--	6
Oppossum	*Didelphis marsupialis*	--	6

* Habitat Type (for higher ranking species only): B-brushlands and shrubs, W-oak woodland, S-grasslands, F-forest, R-riparian.

+ Rank (see Appendix V)

1=Primary resource

2=Secondary resource

3=Tertiary resource

4=Not eaten or probably not eaten

5=Used other than as food resource

6=Rare or may have entered the area only occasionally

Terrestrial Fauna of the North Fork Basin

Table III-B
Reptiles

According to Essene (1942:54) few reptiles were eaten. Some were used by shamans for ritual purposes and rattlesnake doctors may have consumed some species of snakes. No species is considered a significant food resource. Species cited are those in local ethnographies only.

Order	**Family**	**Common Name**
Anura		frogs
Urodela		salamanders
Sqamta	*Anguidae*	alligator lizard
	Colubridae	gartersnake, gophersnake, kingsnake, etc.
	Viperidae	western rattlesnake
	Testudinata	turtle

Terrestrial Fauna of the North Fork Basin

Table III-C
Birds

Common species only and those cited in the ethnographic literature. Quail, Grouse, pigeons ranked as possibly secondary resources.

Order	Family	Common Name
Gaviiformes	*Ciconiforms+*	heron, egret
	*Anseriformes**	mallard, wood duck, etc.
Falconiformes	*Cathartidae+*	turkey vulture, condor (prehistoric period)
	Acciptridae+	hawks, eagles
	Pandionidae+	osprey
	Falconidae+	peregrine falcon
Galliformes	*Tetraonidae**	grouse
	*Phasianidae**	quail
Columbiformes	*Columbidae+*	pigeons, doves
Strigiformes	*Strigidae#*	owls
Apodiformes	*Trochilodae**	hummingbirds
Piciformes	*Picidae+*	woodpeckers
Passeriformes	*Hirundinidae#*	swallow, martin
	Corvidae#	jays, raven, crow
	*Trudidae**	robin, thrush
	Parulidae#	warblers
	Icterdiae#	meadowlark, blackbird
	Fringlillade#	finchs, sparrows

* Essene (1942) reports use as food

\+ Possible use for cultural purposes

\# Use unknown

Terrestrial Fauna of the North Fork Basin

Table III-D
Insects

Only those insects cited by common name in the ethnographic literature as possible food resources are listed. Insects are ranked as tertiary resources.

Order	**Family**	**Common Name**
(various)		catapillars*
Orthoptera	(various)	grasshoppers*
Vespid	*vespula*	Yellow-jacket larvae* (and other species)

* Essene (1942)

Appendix IV

Aquatic Resources of the North Fork Basin

Table IV-A
Anadromous and Resident Species

Notes on the Use of Aquatic Resources

Evidence exists that the inhabitants of the North Fork basin used portions of the southern part of the Mad River drainage and the northern part of the Middle Fork of the Eel River drainage for procurement of aquatic resources (Keter 1993). For example, Lucy Young (Murphy n.d.) mentions people gathering along the Mad River during the summer. At that time, salmon (more likely summer steelhead trout) were taken from large pools in the river.

The Wailaki were said to have a camp near the confluence of the Middle Fork and Fishtown Creek (Merriam n.d.), and the Lassik visited Hoxie Crossing along the Middle Fork (Murphy n.d.). Because of the historic use of the Middle Fork drainage, this region must at least be considered when formulating the potential availability of fish resources for the inhabitants of the North Fork basin. The Middle Fork of the Eel still has a good summer steelhead population.

Table IV-A
Anadromous and Resident Species

Scientific Name	Common Name	Rank+	Comments
Anadromous			
Oncorhynchus kisutch	coho salmon	unknown	main Eel River; unknown for N. Fork
O. tshawytscha	chinook salmon	1	
O. mykiss (anadromous gene)	steelhead trout	1	
Entosphenus tridentatus	Pacific lamprey	2	
Resident			
Catostomus humoldtianus	sucker	3	
O. mykiss	rainbow trout	2	
Hesperoleucus spp.	western roach	3	probably no use due to small size

+ Rank (See Appendix V)
1=Primary resource
2=Secondary resource
3=tertiary resource

Table IV-B
Potential Fish Habitat North Fork of the Eel River System

(Source: Six Rivers National Forest Stream Inventory Files)

Major Course	Tributary	Length (miles)	Fish Habitat Miles	
			Resident	Anadromous
North Fork of the Eel	Main stem	35.8	35.8	35.8
Tributaries North of Hull's Creek				
	East Fork	3.5	2.2	0.7
	West Fork	4.2	2.5 *	1.0 *
	Bar	2.5	0.8	0.2 *
	Bluff	4.5	4.3	0.2
	Bradburn	3.4	2.4	0.2
	Cottonwood	1.5	1.5	0.0
	Dutchman	3.0	0.0	0.0
	Gypsy	1.1	0.3	0.0
	Hoaglin	1.5	0.0	0.0
	Kettenpom	4.3	1.7	0.2
	Lightfoot	4.4	3.7	0.2
	Little Red Mt.	2.6	2.4	0.0
	Panther	2.2	1.0	0.0
	Raglan Gulch	2.2	0.0	0.0
	Red Mountain	4.3	3.9	1.5
	Rock	4.1	1.2	0.2 *
	Salt (North)	2.9	0.0	0.0
	Salt (South)	10.0	8.0	0.8
	Soldier	3.8	0.9	0.2 *
	Tub	4.1	0.0	0.0
	Willow	3.4	1.8	0.5
	Yellowjacket	2.0	0.0	0.0

Table IV-B (continued)
Potential Fish Habitat North Fork of the Eel River System

(Source: Six Rivers National Forest Stream Inventory Files)

Major Course	**Tributary**	**Length (miles)**	**Fish Habitat Miles** Resident	Anadromous
Hull's Creek+@	Main stem	17.7	16.0	4.0
Tributaries of Hull's Creek				
	Casoose	4.5	3.0	0.2
	Hull's Valley	2.0	0.0	0.0
	Horse/Brin	7.5	4.0	0.0
	Pepperwood	2.0	1.0	0.0
Mouth of the North Fork to Hull's Creek+				
	Asbill W. Fork	2.5	1.0	0.2
	E. Fork	1.8	0.5	0.0
	Lousy	1.5	0.0	0.0
	Wilson	4.3	2.0	0.5
	Bear	2.5	0.0	0.0
	Totals:	157.6	101.9	46.6

* Estimate: No fish survey estimates for streams in these drainages are available (These are conservative estimates).

@ Interview data note the presence of steelhead above the falls on Hull's Creek. Conservative estimate of habitat above the falls (includes Hull's and Casoose Creeks) is 8 miles.

\+ Estimate: No actual mileage available.

Appendix V

Ranking of Subsistence Resources

Potential food resources have been classified according to their relative importance in the subsistence procurement strategies of the Wailaki and Lassik as indicated in the ethnographic literature. A second consideration is the seasonal availability and potential abundance of the various resources as presented in the environmental and catchment analysis sections of this study. The classification system is presented below, along with the assumptions and criteria used in evaluating each resource. See Appendixes II, III, and IV for a complete overview of these resources. It should also be remembered that water, even at the end of the Xerothermic Period, was still a scarce resource within the North Fork basin for a significant part of the year. For this reason, access to water was a critical factor. This access is especially important for the processing of acorns (and buckeyes) for the leaching process.

Primary Food Resources

These resources provided a significant portion of the diet for at least a part of the year. Unavailability of any of these resources due to disease, crop failure, or for some other reason could lead to a serious food shortage. Primary food resources were so important that permanent or seasonal settlements were often located at or adjacent to areas where the resources were found. These resources were available in large quantities and either provided a high return on the energy expanded for their collection or other advantages such as storability.

Many of these resources were available on a seasonal-only basis. Often, they were in quantities large enough to support the coming together of the smaller communities for social and cultural activities. Examples of primary resources include anadromous fish, acorns, bulbs, grass seeds, and deer.

Secondary Food Resources

These resources provided an important dietary supplement, especially when the availability of primary food resources was limited because of scarcity or seasonality. They were also desired because they provided variety to the diet, and some may have provided important nutritional needs not available in primary resources. Secondary resources were sometimes available in great quantities (for example, hazelnuts on South Fork Mountain), but for the most part they took more capture or processing time, provided a smaller return on energies expended on their procurement, were not as abundant as primary resources, or were spread across the environment in a pattern that made their use as a primary resource difficult. Some temporary camps may have been established adjacent to areas when secondary resources occurred.

Because of seasonality, a primary resource might become a secondary resource for some portions of the year. For example, although fish were not caught in great numbers in the summer, they were available during that time and had the potential to contribute to the food supply.

Tertiary Food Resources

These resources contributed only minimally to the dietary needs of the local populations. Such resources may have required longer foraging or capture time, were less palatable and were therefore less desirable, were not abundant in the region, or were simply difficult to obtain. Many of these resources were secured opportunistically when encountered in daily life. Some of them may have been desired simply because they tasted good (for example, the sweet-tasting gum of the gray pine cones) or were, like grasshoppers, quite nutritious. Activities to secure these resources are unlikely to have led to establishment of temporary or permanent encampments. The most important thing to note concerning these resources is that they played only a minor role in procurement activities and the selection of encampments.

Resources not Consumed

Although ethnographic data are sometimes contradictory on whether local groups consumed particular resources, many of these resources are so rare (otter) or difficult to secure (grizzly bears) that they would have contributed little to the diet.

Special Use Procurement Items

These resources included materials gathered for religious purposes or to construct baskets, nets, or other cultural or technological products. Although the sites where these materials occurred were visited for specific purposes, most were not occupied for extended period, although in some instances individuals may have spent some time in their vicinity in order to collect or for the practice of religious activities.

*U.S. GOVERNMENT PRINTING OFFICE 1995-0-683-099/22012